ENTRANCES

ENergy TRANsitions from Coal and carbon: Effects on Societies

# Report on Multi-dimensional Key Factors, Dynamics and Patterns

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# Introduction

This report has been drafted in the framework of the project “ENergy TRANsitions from Coal and carbon: Effects on Societies – ENTRANCES”, which is a three-year project funded by the European Union’s Horizon 2020 research and innovation programme. The project addresses the topic “Social Sciences and Humanities (SSH) aspects of the Clean-Energy Transition” and call: LC-SC3-CC-1-2018-2019-2020. ENTRANCES is coordinated by the University of A Coruña and is conducted by a consortium of 14 European partners, including universities, research institutes, networks and umbrella organisations.

ENTRANCES’ **overall goal** is developing a theoretically-based and empirically-grounded understanding of cross-cutting issues related to SSH aspects of the clean energy transition in European coal and carbon-intensive regions and formulating a set of recommendations able to tackle these issues. To achieve this goal, the project investigates the challenges facing carbon-intensive regions in transition hinging on the idea that the transition to clean energy should not be considered only as a technological change or an industrial shift but also as a complex and multidimensional process that affects the daily life of local communities. In this regard, the project understands the impacts of the clean energy transition on coal and carbon-intensive regions, either in terms of the potential activation or strengthening of the **deterritorialisation process**, i.e., the process of progressive weakening of ties between a community and its territory, and conversely as a window of opportunity for triggering their **reterritorialisation**.

One of the key aspects of the project was thus **setting-up a conceptual framework** able to grasp the multi-faceted aspects of the de/re-territorialisation processes ongoing in the European coal and carbon-intensive regions in transition. In this regard, the first Work Package of the project has developed the conceptual side of the ENTRANCES' Multidimensional Analytic Framework (MAF), which is based on five components –addressing different dimensions of change – and articulated in a set of key factors, dynamics and patterns.

The conceptual framework is the basis for developing a coherent methodological framework, which in turn, will be used to develop a set of regional case studies on coal and carbon-intensive regions in transition. Moreover, the conceptual framework provides input for other activities foreseen in the later stages of the project, i.e., the comparative analysis among the case studies, and the development of regional transition scenarios.

In this regard, the report can be considered primarily as a “conceptual tool” to be used by the ENTRANCES research teams in the different stages of implementation of the project. Nevertheless, the report, as a public document, has also been drafted for being accessed by external users, such as other researchers in the area of energy transition and sustainability, or the local stakeholders that will be involved in the research.

The report is structured in four chapters.

Chapter 1 presents the starting points, objectives, approaches and activities of the **conceptual specification work** conducted for developing the conceptual framework.

Chapter 2 presents the **conceptual framework as a whole**, and thus provides an overview of the framework organisation and rationale useful for better understanding the context in which the more specific parts of the framework – i.e., components, and factors, dynamics and patterns – are inserted.

Chapter 3 presents, one at a time, the key features of the **five analytical components** of the framework.

Chapter 4 presents the multidimensional list of **factors, dynamics and patterns** across the five components of the framework.

In addition to the main text, the deliverable also includes **five annexes**, i.e., five short reports each providing more detailed information on the five analytical components and the related factors, dynamics, and patterns, the main text makes constant references to them.

**Contributors to the report**

The report has been drafted by G. Caiati (K&I) with the joint efforts of many researchers from the ENTRANCES consortium. Specifically, the team of K&I, composed of G. Quinti, M. Cacace, and F. Feudo, has provided inputs to and revised the whole text, and has contributed to "Chapter 1 – Conceptual Specification", the "Para. 3.1 – Socio-cultural component" and "Para 4.1 – Socio-Cultural Factors". R. Garcia Mira (UDC), as project coordinator has revised the whole text as well and has contributed to "Para 1.1.1 – ENTRANCES Research Questions". The team of UDC, composed of R. Garcia Mira, N. Singh Gartha, F. González Laxe, and F. J. Rey Vizoso, has contributed to "Para. 3.2 – Socio-Psychological Component" and Para 4.2 "Socio-Psychological Factors". The team of CSPS, composed of R. Filčák and D. Skobla, has contributed to "Para 3.3 – Socio-Political Component" and "Para 4.3 – Socio-political factors". The team of IWH, composed of O. Holtemöller, and K. Heinisch, and C. Schult has contributed to "Para 3.4 – Socio-economic component" and "Para 4.4 – Socio-economic factors". The team of IOER, composed of M. Wolfram, T. Barrett, and R. Knippschild, has contributed to "Para 3.5 – Socio-ecological and technical component" and "Para 4.5. – Socio-ecological and technical factors". A. Rühlemann, M. Kushan, and M. Norena of WECF, have contributed to all the gender-related paragraphs in Chapter 1 and 4. E. De Luca of ENEA, provided some text integrations of different factors presented in Chapter 4. Finally, M. Spiesberger, of ZSI, contributed to "Para 2.4 - Foreseen methods", C. Klöckner of NTNU, contributed to "Para 2.2 – Research Issues", and A. Haley of CU, contributed to "Para 2.3 – Multiple Units of Analysis", A. Holman and S. Boncu of UAIC contributed to "Para 2.1 – Framework organisation" and "Para 2.5 – Synopsis".

The five short-reports attached in the Annex have been produced by the teams in charge of specifying the different components and namely: Annex 1 (short-report on the socio-cultural component) has been drafted by K&I; Annex 2 (short-report on the socio-psychological component) has been drafted by UDC; Annex 3 (short-report on the socio-political component) has been drafted by CSPS; Annex 4 (short-report on the socio-economic component) has been drafted by IWH; Annex 5 (short-report on the socio-ecological & technical component) has been drafted by IOER.

# 1 The Conceptual Specification Work

## 1.1 Starting points and objectives

*The conceptual specification work has been based on four starting points that will be presented in this paragraph: the research questions of ENTRANCES (Para 1.1.1), the envisaged features of the MAF (Para 1.1.2), the region selected by the project for the case studies (Para 1.1.3), and the adoption a perspective of scientific cooperation based on pluralism (Para 1.1.4). In the light of these starting points the objectives of the conceptual specification are presented in the last paragraph (Para 1.1.5).*

### *1.1.1 ENTRANCES research questions*

The **first starting point** for the conceptual specification work has been the research questions of the project. Based on the ENTRANCES objectives a set of three research questions have been made explicit and singled-out.

1) What are the principal socio-economic, socio-technical, socio-ecological, socio-cultural, socio-political, socio-psychological, and gender-related challenges facing coal and carbon-intensive regions in transition? What coping strategies have emerged in recent years?

2) What variables have been most influential in the appearance of the deterritorialisation process and how do they interact? What kinds of strategies are the key determinant of success in terms of reterritorialisation?

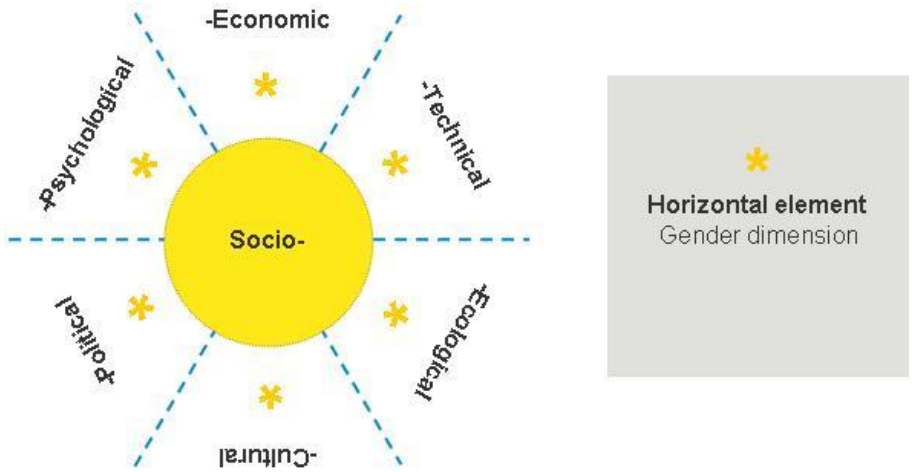
3) What policies or combination of policies would be most appropriate to recover the ties of the territory and community in coal and carbon-intensive regions while fostering their transition toward clean energy?

The conceptual specification, thus, has been oriented by such questions since it aimed at developing a framework able to answer them.

### *1.1.2 The envisaged features of the Multidimensional Analytic Framework*

To answer the research questions presented above, ENTRANCES envisaged since its conception the adoption of a **Multidimensional Analytic Framework** (MAF) articulated into six components: socio-cultural, socio-psychological, socio-political, socio-economic, socio-ecological, and socio-technical components, with gender as an additional horizontal dimension. The Multidimensional Analytic Framework, which in its initial design is represented in the figure below, can be considered the **second starting point** of the conceptual specification.

Figure 1 - the Multidimensional Analytic Framework as envisaged in the project proposal




During the implementation of WP1, the socio-ecological and socio-technical components were merged into one component. The reason was that they both adopted as approach the already shared perspective of Socio-Ecological and Technical System (SETS) and its research into transformative capacities (see Para 3.5). For this reason, and for making the reading of this document easier, from now on we will refer to the following **five components** of the MAF:

- C1: socio-cultural component
- C2: socio-psychological component
- C3: socio-political component
- C4: socio-economic component
- C5: socio-ecological & technical component.

### *1.1.3 The features of the set of regions*

The research questions of the ENTRANCES project will be investigated through the adoption of the Multidimensional Analytic Framework in a set of 13 European coal and carbon-intensive regions in transition. In this regard, a **third starting point** for the conceptual specification is constituted by the features of the coal and carbon-intensive regions included in the project.

Such regions have been selected based on a common background: their dependence on coal or other fossil fuels as they heavily depend on fossil-fuel-based industries or the extraction of fossil fuels themselves. The selected regions have been conventionally divided into two groups: “coal mining regions” − regions in which coal mines are still active − and “other carbon-intensive regions” collecting all the other cases. The regions included in the study are reported in the table below.

Table 1. List of the regions selected for the case studies

| Coal mining regions | | Other carbon-intensive regions | |
|---|---|---|---|
| **Region** | **Country** | **Region** | **Country** |
| Silesia | Poland | Brindisi | Italy |
| Lusatia | Germany | Kraków MA | Poland |
| Rhineland | Germany | A Coruna | Spain |
| Central Germany | Germany | Upper Styria | Austria |

| Coal mining regions | | Other carbon-intensive regions | |
|---|---|---|---|
| **Region** | **Country** | **Region** | **Country** |
| Jiu Valley | Romania | Stavanger | Norway |
| Upper Nitra | Slovakia | South Wales | United Kingdom |
| Sulcis | Italy | | |

On the one hand, the selected regions present a **variety of situations**. Some of them are both extracting coal and using it for power generation or industries. In some other, the mines have already been closed but coal is still a key asset for industries and power generation. Some other cases, have never been mining regions but are intensively using coal. Overall, all the regions are dealing with phasing out of coal, except for the case of Stavanger (Norway) which is focused on the extraction of oil. Thus, the conceptual framework is expected to be flexible enough to consider the different features of the regional cases selected.

On the other hand, despite their differences, **all the selected cases are facing or should face in the near future similar challenges**. As a matter of fact, decarbonisation is already happening in the coal regions (production and consumption of coal have been in steady decline). Moreover, coal phase-out has been decided, announced, discussed, or at least evoked in almost every country. As far as the "oil" region of Stavanger (Norway) is concerned, it has recently announced a disinvestment plan for oil and gas that will directly impact the regional economy. In synthesis, even though there are differences between regions on when full decarbonisation will be possible, all the selected regions are affected or will be affected by similar dynamics. The conceptual framework, therefore, needs to be able to catch the distinctive features that characterise the transition of these regions.

### *1.1.4 Pluralism*

For studying the complex and multidimensional dynamics characterising the de/re-territorialisation processes, ENTRANCES embraces **theoretical and methodological pluralism** – a perspective in which the adoption of different scientific approaches is not considered as a problem but as an asset – as its research strategy and it relies on a process of knowledge integration (Isgren et al., 2017). In this regard, the project yearned for adopting multiple approaches but without losing their distinctive ontological, epistemic, theoretical, and methodological features (Olsson and Jerneck, 2018). The choice to embrace theoretical and methodological pluralism can be considered the **fourth starting point** of the conceptual specification.

This perspective **differs from other forms of scientific cooperation** that are commonly adopted in research practice, such as the *unification perspective,* which merges the disciplines or their epistemologies, theories, and methods into a brand new unified approach; the *hybridisation perspective*, that dissolves the different approaches in a not-specified melting pot of methods (Ahmed and Sil, 2012); and the *pillarisation perspective*, in which the different disciplines work on separate silos (Keating and Della Porta, 2010), thus failing to understand the relationship existing between the various aspects of the de/re-territorialisation processes.

### 1.1.5 Objectives: specification and integration

The overall objective of the conceptual specification work is that of specifying the conceptual side of the Multidimensional Analytic Framework for the development of a set of regional case studies in the 13 coal and carbon-intensive regions, so as to allow to answer the research questions of ENTRANCES. The four starting points presented above allows us to better understand how this overall objective can be articulated in the following two practical objectives:

- ***Factors specification***, i.e., to articulate each of the "socio" components of the MAF in a list of factors, dynamics, and patterns that fit with the research questions and with the case studies included in the project.

- ***Components integration***, i.e., to put together such components in a coherent framework, thus fostering complementarity and avoiding overlaps among them, but still relying on their singular distinctive theoretical and methodological insights.

While pursuing the first objective will allow putting the underlying approaches of each component in the context of ENTRANCES research (i.e., coal and carbon-intensive regions in transition), the second one aims at fostering multidimensional knowledge integration and ensuring the feasibility of the approach within the limited framework of the project.

## 1.2 Approaches

*The two objectives presented above have been pursued by adopting two parallel and intertwined approaches that are presented below.*

### 1.2.1 Approach to factors specification

The factors specification consisted of articulating each component in a **list of factors, dynamics, and patterns**.

The term **factor** refers to single elements/phenomena that contribute to determining the processes of change under investigation in each component (e.g., socio-cultural or socio-economic change, etc.). The term **dynamics** refers to trends emerging from the interaction among two phenomena relevant to the changes considered in each component and, ultimately, with deterritorialisation/re-territorialisation processes. The term **patterns** refers to recurrent or stable configurations of elements/phenomena which can be observed in different places, times, or scales.

The aim has been that of specifying those aspects that "ex-ante" are expected to be distinctive of the transition towards clean energy of coal and carbon-intensive regions. In this way, the adoption of a broad multidimensional framework will be made feasible by focusing only on those aspects that can be considered constitutive elements and, therefore, distinctive of the process under investigation. For each component the specification of factors, dynamics, and patterns has been:

i. based on a specific approach
ii. updated with literature
iii. selected through multidisciplinary dialogue.

An overview of the approaches adopted and the literature surveyed is offered in the table below.

**Table 2 – Component and approaches adopted in ENTRANCES**

| Component | Socio-cultural | Socio-psychological | Socio-political | Socio-economic | Socio-ecological & technical |
|---|---|---|---|---|---|
| **Approach** | Socio-cultural stress | Place attachment | Technological Drama | Structural change model | Socio-Ecological & Technical System (SETS) |
| **Literature** | De-industrialised and declining regions | Place, identity & migrations | Populism and energy transition | Models of economic transformation | Coal and carbon-intensive regions |

The outcome of this process has been the specification – for each of the five "socio" components – of a list of distinctive factors, dynamics, and patterns.

### *1.2.2 Approach to components integration*

The integration of the different components into a coordinated multidimensional framework has been based on two complementary knowledge integration mechanisms: a) scientific repositioning, and b) component assemblage.

a) The concept of **repositioning** highlights the need that the approach behind each of the MAF components should be adjusted so that it can match with the others, to form, overall, a coherent and meaningful research scheme, but without losing its distinctiveness and added value. Using the metaphor of the Tetris game, each approach should be moved (repositioned) to match with the others. The re-positioning process has been based on the following three elements.

- *Making the components explicit*. The distinctive features of each component of the MAF have been made explicit and communicated with the others by using a common language developed within the project.
- *Mutual understanding*. For a successful repositioning, the partners in charge of the different components must have an appropriate understanding of the other components approach and views. The project promoted mutual understanding by organising a set of six research colloquia, i.e., meetings for discussing in-depth one component at a time.
- *Double feedback loop*. A better understanding of the other components triggers a self-reflection on each component by each concerned research team that allows adjusting the original approach (as previously formalised) to make it more fitted with the others, thus **activating the repositioning mechanism**.

b) The process described above is focused on the repositioning of each component. In the ENTRANCES project, this process, which can be considered a necessary but not sufficient condition for knowledge integration, is complemented with the **assemblage mechanism**, i.e., combining the different analytical components in a common coherent framework. The assemblage approach seemed the more appropriate mechanism to favour a knowledge integration in the light of the scientific pluralism needed by ENTRANCES. In fact, following DeLanda (2019), an assemblage is formed by heterogeneous entities that are not holistic (as in the case of the components of the MAF), and in which the assemblage coherence co-exists with the internal coherence of each of its components. Moreover, an assemblage is not based on a central plan (in

our case the components have been not deductively defined following a common rationale), rather it is formed by an ad-hoc grouping process that develops in a given time span. Following these principles, the different components of the MAF have been assembled through an intense itinerary of scientific dialogue, made up of three steps.

- *Developing an assemblage rationale*, i.e., the overall rationale of the framework, based on an interpretation of the components and of their possible specific role in the framework.
- *Identifying the critical juncture*, i.e., how each component relates to the others at different levels: for their domain of inquiry (conceptual juncture), for their regional unit of analysis (territorial juncture), and for their foreseen methods (methodological juncture). The identification of these junctures aimed at fostering complementarities and avoiding duplication of research among the components.
- *Providing a synthetic and visual representation* of the assemblage, thus contributing to developing a common understanding of the conceptual framework as a whole.

The **two mechanisms of repositioning and assemblage are strongly interlinked**. On one hand, the repositioning mechanism is a pre-condition of the assemblage, as it makes explicit the features of each component and already orients the conceptual specification toward a common vision. On the other hand, the assemblage provides a comprehensive insight on how each component should be "repositioned" to create a better assemblage with the others.

## 1.3 Work phases and activities

*Based on the approach presented above, the work has been organised in different work phases that are presented in Para 1.3.1 Moreover, the list of the activities carried out during the conceptual specification work is reported in Para 1.3.2.*

### *1.3.1 Work phases*

Overall, the conceptual specification has been operationalised in an itinerary articulated in the following four phases.

- ***Set-up phase*** *(May – June 2020)*. It was the phase dedicated to setting up and organising the conceptual specification work. In this phase, a set of information and tools for conducting the collection of factors, dynamics, and patterns have been provided and formed the basis for the D1.1 "Factors Description Grid".
- ***Identification phase*** (*July – Oct 2020*). In this phase, the conceptual specification work was focused on identifying through a scoping review of the literature the factors, dynamics, and patterns related to the different components to be included in the framework. Moreover, in this phase, the five components have been further formalised using a common template.
- ***Harmonisation phase*** (*Oct – Nov 2020*). This phase was dedicated to fine-tuning, harmonising, and coordinating the five components among each other, and to complete the identification of factors, dynamics, and patterns started in the previous phase.

- ***Reporting phase*** (*Dec 2020 – Feb 2021*). This phase was dedicated to synthesising the work done for each of the components and overall.

### *1.3.2 Activities*

The activities conducted for the conceptual specification can be distinguished between those carried out in parallel for the specification of the five components and those carried out in the cross-cutting workspace.

The main activities carried out in parallel for the specification of the five components are described below.

- *Scoping review of the literature*. Five different research teams, one for each of the five components, have conducted a scoping review of the literature aimed at updating and adapting the approach adopted to the case of coal and carbon-intensive regions and to identify the factors, dynamics, and patterns to be considered in the framework. Overall, more than 400 texts have been selected and analysed as relevant for the research[1].

- *Description of the five components*. Each component has been made explicit and fully defined different aspects such as the domain of enquiry, the theories adopted, the foreseen methods, etc. This work has been done thanks to the development of a Component Description Template[2].

- *Description of factors, dynamics, and patterns*. The individual factors identified during the scoping review of the literature related to the different components have been described and classified following a common Factor Description Template. Overall, a set of 62 factors, 7 dynamics, and 18 patterns have been identified.

- *Reporting*. For each of the five components, a short report on key factors, dynamics, and patterns of the concerned component has been drafted. These reports are annexed to this document.

The activities conducted under the cross-cutting workspace can be summarised as follows.

- *Crosscutting workspace meetings*. Three meetings have been conducted among all the research teams involved in discussing the key passages between one phase and another of the conceptual specification work. In particular, the first meeting was dedicated to presenting the tools and methods developed in the set-up phase, and to start the identification phase; the second meeting was dedicated to presenting the core results of the scoping reviews of the literature and to discuss the assemblage rationale for the harmonisation phase; the third meeting was aimed at discussing the conceptual framework as a whole as it was assembled and in paving the way to the reporting phase.

[1] The 5 scoping reviews of the literature are presented in the “short-report” produced on each of the components that are annexed to this deliverable.
[2] The Component Description Template and the Factor Description Template have been presented in detail the project deliverable “D1.1 - Factor Description Grid”.

- *Research colloquium*. A set of six research colloquia have been organised, dedicated to present, one at a time, the five components[3], to describe the results of the concept specification work but also to discuss more in-depth the approaches underlying the five components.

- *Assemblage Workshop.* A set of four assemblage workshops have been conducted to assemble, one at a time the five components taking as a starting point the socio-cultural component (C1). During each workshop, the critical junctures (conceptual, territorial and methodological junctures) have been discussed and clarified. In each workshop, an expert researcher of the consortium not directly involved in the specification of the five components participated with the role of facilitator.

- *Other meetings*. In addition to the meetings, colloquia and workshops mentioned above, the work has been accompanied by different rounds of bilateral meetings and 2 interim workshops, all devoted to an exchange of information among the research teams involved in the component specification. In total, 35 bilateral meetings and 15 multilateral project meetings (including those described above) have been conducted, all in online mode.

- *Gender mainstreaming*. A specific stream of activities has been dedicated to gender mainstreaming. These activities included a capacity building session on gender mainstreaming in research addressed to the project partners; a gender-focused scoping review of the literature, aimed at integrating the scoping review already conducted for the development of the five components; a set of bilateral meetings conducted to discuss the gender dimension in each of the five components; a gender mainstreaming check-up, devoted to checking whether the conceptual specification has taken appropriately into account the gender dimension and suggesting integration and amendments.

- *Reporting*. The conceptual specification work has produced two deliverables: D1.1 Factor Description Grid, providing theoretical and practical tools for the work, and D1.2 Report on Multidimensional Key Factors, Dynamics and Patterns, i.e., the present document.

- *Work coordination & tools development*. The conceptual specification work has been supported and informed by strong coordination among all the involved partners, made possible by timely planning of the activities and exchange of information. Moreover, a set of practical tools have been produced to facilitate the work and create common understanding and outcomes, including a Component Description template, a Factor Description Template, the Explicit Research Questions, an Ex-ante Conceptual Map, an Ex-ante Case Description Map. These tools and their use have been presented in detail in D1.1. Factor Description Grid.

[3] The socio-ecological & technical component has been presented in two separate colloquia, so a total of 6 research colloquia have been organised.

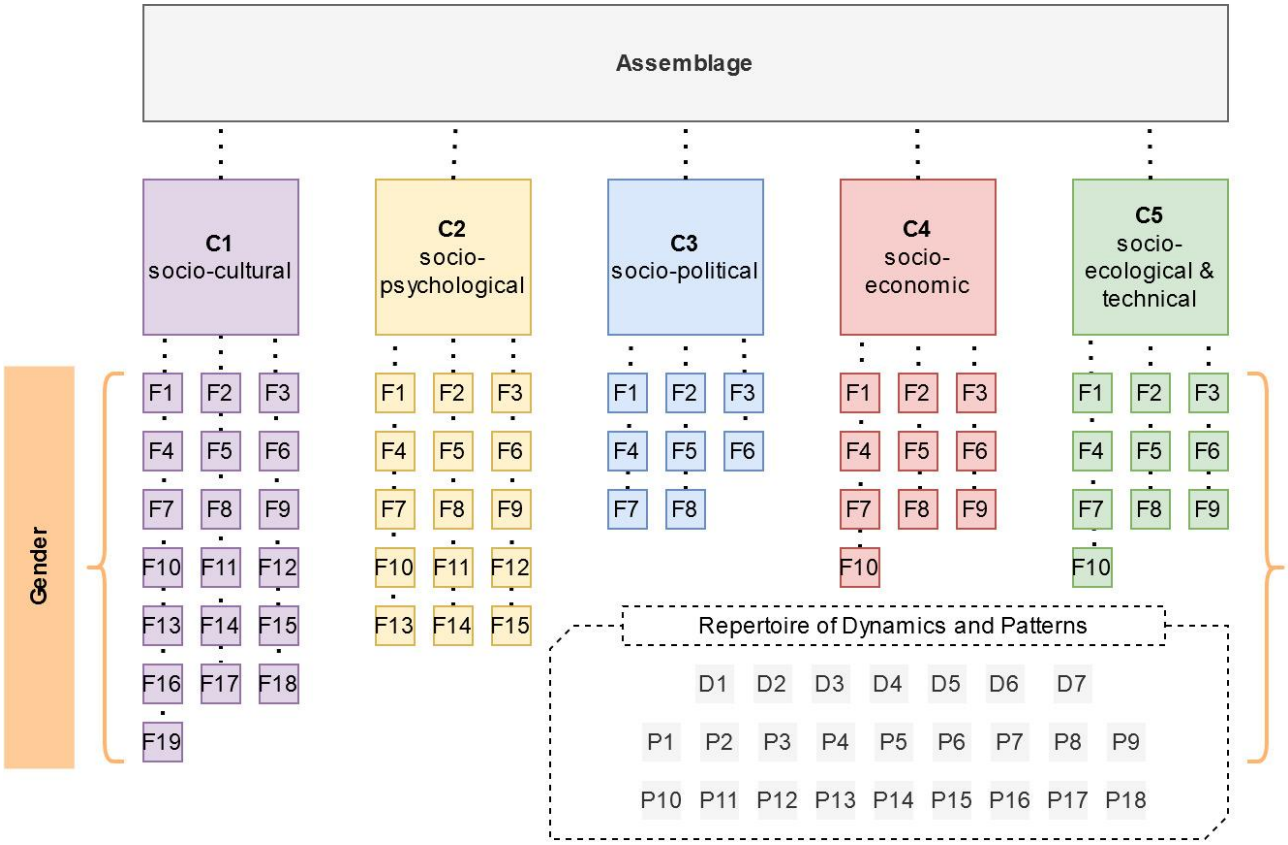
# 2 The Conceptual Framework

## 2.1 Organisation

### *2.1.1 Levels of organisation*

The conceptual framework has been developed and organised across four different levels: assemblage, components, factors, and dynamics & patterns, as represented in the figure below.

**Figure 2: The organisation of the conceptual framework across different levels**




The **assemblage** is the broader level of the framework and sets up the overall rationale of the research to be conducted in the regional case studies. It also defines how the different components complement each other and what are the relationships among the different components that can be explored in the case studies.

The **components** are the *structural "building blocks"* of the framework as each component is characterised by its ontology, epistemology, theoretical and methodological features. As stated above, the conceptual framework is organised into five different components that will be presented in-depth in Chapter 3.

For each component, a set of **constitutive factors** has been identified. The factors represent the *analytical "building blocks"* of the framework, as they will be translated into the different "items" or "questions" to be addressed in the empirical research. The number of factors varies depending on

the components, as in each component the factors play a different role[4]. In total, 62 factors have been included in the framework.

Finally, the conceptual framework also includes a **repertoire of dynamics and patterns**. Differently from the factors, which are conceptualised as determinants contributing to the specific changes analysed in each component, the dynamics and patterns identified represent possible alternative trends (dynamics) or complex configuration (patterns) aimed at interpreting the situation of the region as a whole. The presence of such dynamics and patterns, thus, should be assessed and described through the information collected with all five analytical components. In this regard, the repertoire of dynamics and patterns will be particularly useful for the **comparative analysis** – through which a taxonomy of the regional trajectories will be devised –, and for the **models and simulation** – through which a set of regional scenarios will be developed. Both activities are foreseen in the later stages of the project[5]. In total 7 dynamics and 18 patterns have been included in the framework.

Moreover, Factors, Dynamics and Patterns have been assessed and specified from a **gender-perspective**, as they are not "neutral" processes but have different implications on men and women. In total 47 factors (out of 62) have proven to be gender-sensitive.

The level of the assemblage will be deepened in the other paragraphs of this chapter, while the other levels will be deepened in the next chapters.

### *2.1.2 Critical junctures*

The assemblage of the five components of the framework has been organised across three critical junctures, that together define the overall features of the framework:

- **Conceptual juncture** is the level at which the different components of the framework have been harmonised in a unique coherent framework. At this level, the complementarity and the interrelation among the domain of enquiry of the five components have been explored. This level of the assemblage will be presented in Para 2.2. - Research issues.

- **Territorial juncture** is a key aspect, as the different components have a different conceptualisation of what "a region" is. In this regard, as all the components will be used to describe the cases, each case study will be analysed and described as the stratified product of different interrelated regional units of analysis. The territorial juncture helped to identify how the territorial scope of the case studies will be established across these different units to adopt the same approach in each case study. This level will be presented in Para 2.3 - Units of analysis.

- **Methodological juncture** is a description of how the different components should inform the methodological side of the Multidimensional Analytic Framework. This aspect will be deepened with the activities of WP2 but it is presented in its envisaged features in Para 2.4 – Foreseen methods.

[4] In some cases, factors with similar names can be found across different components. Despite their similar names, such factors always have a different analytical focus (often complementing each others) as they are referred to different domains of enquiry and units of analysis (see Para 2.2 and Para 2.3).

[5] While the factors will be used in WP2 to develop the methodologies connected to each of the individual components, the repertoire of dynamics and patterns will be used in WP5 – comparative analysis and WP6 – knowledge co-production and recommendation.

Finally, the chapter will be completed with a synoptic table (Para 2.5), summarising all the conceptual, territorial, and methodological juncture of the conceptual framework.

## 2.2 Research issues

### *2.2.1 Overview of the research issues*

The research issues of the conceptual framework can be summarised as follows.

- **Socio-cultural component (C1)**. The component starts from the assumption that de-carbonisation is only one of many globalisation-induced processes impacting the territorial organisation of coal and carbon-intensive regions. These regions, similarly to other areas – such as peripheral regions, sparsely populated areas, former industrial regions, mountain regions, small islands, etc. – seem to be particularly exposed to the deterritorialisation processes triggered by the socio-cultural change associated with globalisation. In this regard, the socio-cultural component aims at assessing how different global cultural flows (e.g., flows of people, ideologies, money, media, technologies, and non-human elements) are producing **stress and strains** – in terms of conflicts, tensions, ambiguities, or blocks – affecting the territorial organisation.

- **Socio-psychological component (C2)**. Coal and carbon-intensive regions are experiencing broad transformations at the territorial level. The socio-psychological component will look at how citizens are reacting to such transformations. Looking at different cognitive and emotional dynamics – including **place attachment**, and decarbonisation-induced psychological impacts, but also individual resilience – the socio-psychological component will investigate the key factors which are contributing to different **coping strategies**, such as the intention to migrate, resistance to change, submission, await or personal transformation.

- **Socio-political component (C3)**. Following the approach of "technological drama", this component interprets technological change – in our case, the energy transition – as a political process pursued with technological means. In other terms, with the lens offered by this component, the technological process is understood as locally shaped by the interaction of key stakeholders and new emergent actors operating for acquiring, consolidating, or defending their position in the **local field of power**. Through analysing the narrative battles for the interpretation of the energy transition ongoing in coal and carbon-intensive regions, the socio-political component will study how local actors are aggregating around different "constituencies" for regulating, adapting, or opposing to the energy transition. Moreover, the component will analyse how the action of such constituencies is accelerating or slowing down the transition process.

- **Socio-economic component (C4)**. Through the lens of the socio-economic component, the de-carbonisation of energy production and industrial processes cannot be considered only as a material and technical shift in production, but also as a broader **structural change** in the regional economy with multiple consequences for the involved regions.

Leveraging on a model already developed for assessing structural change at the regional level in Germany – which includes energy and non-energy production sectors, regional consumption, regional incomes, labour-market dynamics, fiscal transfers between regions, price adjustments, and migration – the socio-economic component will analyse the current situation and the potential impact of the energy transition on labour-markets and the economic development in the coal and carbon-intensive regions.

- **Socio-ecological and technical component (C5)**. This joint component uses socio-ecological and socio-technical systems-thinking to assess the **transformative capacity** available in case study regions, focusing on the respective regional economic development system involved in shaping their decarbonisation pathways. The component is based on the assumption that, in principle, different future decarbonisation pathways are always possible. Through focusing on transformative capacity, the socio-ecological and technical component will investigate how far a region is actually able to deviate from its current (carbon-intensive) path.

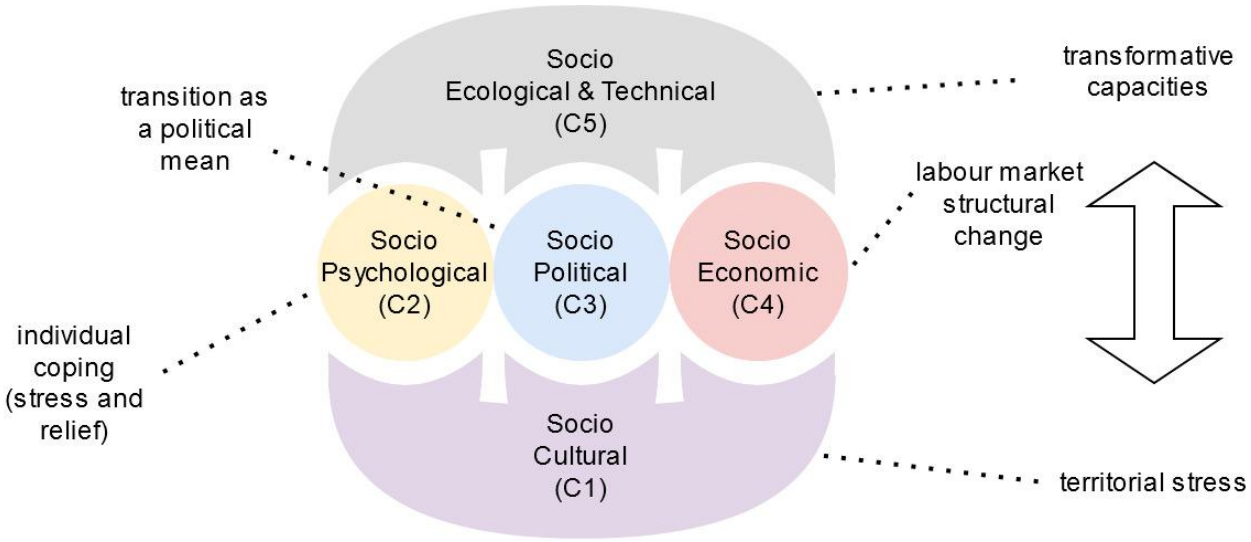
### *2.2.2 Conceptual juncture*

The research issues of the five analytical components are kept together by a conceptual juncture that allows interpreting them all together in a single analytic framework. The framework can be represented as an **egg with three yolks contained by two half-shells**, as shown in the picture below. The shells represent two horizontal components (C1 and C5), which define the boundaries of the framework. The three yolks represent three specific components (C2, C3, and C4) that analyse specific fields of action/sectors of the regional system.

- **Horizontal components**. Starting from below, the socio-cultural component (C1) is focused on territorial stress, thus it investigates the pressure which the coal and carbon-intensive region are exposed to. On the other side, the socio-ecological & technical component (C5) is focused on transformative capacities, thus representing the system capacity to create a new system and to regenerate and transform the region. The two shells can be also considered as two poles of the process of change investigated in the research: stress on one side and transformation on the other side. In this sense, the two horizontal components can be understood as defining the conceptual boundaries of the case studies.

- **Specific components.** As already said, the socio-psychological component is focused on individual coping strategies, the socio-political component is focused on power reconfiguration, while the socio-economic component is focused on the structural change in the regional economy as such, (e.g., new fields of growth, decline of the economy, etc). In synthesis, each component is focused on a different dimension of change ongoing in the region and refers to different, albeit intertwined, fields of action. It is worth stressing that each of these components, by adopting a specific heuristic, will take into consideration the intrinsic complexity of the processes under examination thus highlighting the rules of the game in the different examined dimensions, i.e., emotion and cognition, power relations, and market dynamics.

Figure 3: The Multidimensional Analytic Framework (MAF)




Based on this rationale, it is possible to identify a set of interactions among the different components that are synthetically described below.

- **Interactions between the two horizontal components**. The two horizontal components have complementary roles in the framework and they dialectically interact. While C1 will analyse which are the socio-cultural drivers that create stress in the territorial system and that potentially can trigger processes of deterritorialisation and reterritorialisation, C5 will assess what is the capacity of the system to deal with these ongoing processes and for effectuating deep and holistic regional changes.

- **Interactions between the three specific components**. Albeit working on different dimensions (emotion and cognition, power relations, and market dynamics), the three components are deeply interrelated, as each component has casual impacts over the other two. For example, the individual coping strategies affect both the transformation in the labour market and the change in power relations accompanying the energy transition in the region. Albeit the project will not adopt an ex-ante approach that formalises these relationships, the interactions among the three specific components will be explored based on the evidence collected across the case studies.

- **Interactions between the specific components and the bottom shell**. The analysis of socio-cultural stress intersects the specific components projecting them on the territory. In this regard, the socio-cultural component studies how the socio-psychological, socio-political, and socio-economic processes produce stress at the territorial level. At the same time, socio-cultural stress can be an important factor influencing the specific components.

- **Interactions between the specific components and the upper shell**. The analysis of the transformative capacity intersects the specific components projecting them on governance. Moreover, the socio-ecological & technical component provides important “interstitial” knowledge across the specific components.

## 2.3 Multiple units of analysis

### 2.3.1 Territorial juncture

Each of the five components has a different geography of interest. The socio-cultural and socio-psychological components are predominantly concerned with the 'Coal and Carbon Territory' (CCT), i.e., the territory directly affected by the decarbonisation process. The socio-economic component is predominantly concerned with the opportunities offered in the prevailing 'Labour Market Area' (LMA) and how this might change. The socio-political and socio-ecological and technical components are predominantly concerned with the effective governance and administrative scales, that can be observed starting from the 'Political Administrative Region' (PAR) more closely associated with governing the transition of the coal and carbon territory.

**Table 3: Components of the MAF and units of analysis**

| Component | Unit of Analysis |
|---|---|
| Socio-cultural | Coal and Carbon Territory (CCT) |
| Socio-Psychological | |
| Socio-Economic | Labour-Market Area (LMA) |
| Socio-Political | Political Administrative Region (PAR) |
| Socio-ecological & technical | |

The territorial juncture – i.e. the coal and carbon-intensive region as a whole – is then composed by the Coal and Carbon Territory and the wider extension of this area to consider the Labour Market Area and the Political Administrative Region. ENTRANCES will thus develop regional case studies, in which each case is defined by three interrelated and overlapped units of analysis: CCT, LMA, and PAR.

### 2.3.2 Overview of the units of analysis

The delineation of each unit of analysis will be set out by each case study but will be based on a common approach. The three units of analysis of the framework, including their interpretation and delineation criteria are schematically presented below.

**Coal and Carbon Territory (CCT)** ► *Components*: socio-cultural (C1) and socio-psychological (C2). ► *Interpretation*: It is the territory directly affected by the decarbonisation process, as it is the territory heavily dependent on fossil-fuel-based industries or the extraction of fossil-fuels themselves. It can be considered the "fulcrum" or the "core" of the case study. ► *Definition*: The territory in which the "coal and carbon" features are represented as a distinctive part of the local identity or are a key asset for the income and employment opportunities of the local community. ► *Delineation:* The CCT will be delineated considering jointly: a) the set of Local Authority Units (LAUs) which are

recognised as a "coal and carbon area" by the local community; and b) set of Local Authority Units (LAUs) recognised as a “coal and carbon area” by external observers (e.g., in previous research). In case the two criteria above are not available or if a significant difference is found, another supplementary data-driven criterion can be used: c) the set of LAUs where the plants, industries, or extracting sites are based; where the residences of the workers of the mines, plants, or industries are concentrated; where the local direct environmental impacts are concentrated.

- **Labour Market Area (LMA)** ► *Components*: socio-economic (C4). ► *Interpretation*: LMA can be interpreted as the structural economic context in which the coal and carbon territory is inserted. It can also be understood as the area where workers are available to commute once mines, power plants, or industries of the CCT will be closed. ► *Definition*: The area in which a bulk of the labour force live and work, which includes the Coal and Carbon Territory. ► *Delineation:* The LMA will be delineated by identifying one or more contiguous NUTS3 regions including the “Coal and Carbon Territory” and belonging to the same country. The NUTS3 regions to be included in the Labour Market Area will be determined based on previous studies or resorting to local expertise.

- **Political Administrative Region (PAR)** ► *Components*: socio-political (C3) and socio-ecological & technical (C5) ► *Interpretation*: The transition of the coal and carbon territory is influenced by actors, processes, and relations operating at different governance scales. The PAR can be understood as a meso-level political and administrative unit that offers a governance space at the interface between processes and actors operating at the higher levels (e.g., at national and European level) and those operating at the lower political and administrative levels (e.g., local authorities). ► *Definition*: The Political and Administrative unit which is most closely associated with governing the transition of the Coal and Carbon Territory through a directly-elected legislature. ► *Delineation:* The administrative level to be considered is the one in which a recognizable policy agenda addressing the transition of the coal and carbon territory can be singled out.

## 2.4 Designated methods

### *2.4.1 Overview of the methods*

For each of the five components, a specific research module (i.e., a coordinated sequence of research activities involving one or more methods), is being developed through methodological specification, which is not covered in this report[6]. Nevertheless, the conceptual specification work allowed to provide an insight into the envisaged features of such modules, including their primary method, i.e., the method that will be prevalently adopted in the module. In this regard, an overview of the research modules is provided below.

- **Socio-cultural component**. The component will develop a research module aimed at assessing the socio-cultural stress induced by global cultural flows in the coal and carbon territory. The effect of different global processes (e.g., migration, digitisation, the rise of

[6] Such a work is currently ongoing under the Work Package 2 - Methodological Framework.

populism, etc.) will be assessed in terms of stress-strains produced at the territorial level through the involvement of the local key informants in a rapid appraisal exercise. ► *Primary method:* Focus Group.

- **Socio-psychological component**. The research module of this component will analyse to what extent different cognitive and emotional dynamics contribute to determining a set of different coping strategies of inhabitants of the Coal and Carbon Territory. The research module will be based on assessing individual psychological-scales through an online questionnaire and putting them against the features of the regional context. *Primary method:* Survey.

- **Socio-political component**. The socio-political component will devise a research module based on the semantic analysis of statement and counterstatement of different social actors about the energy transition and coal phase-out. The module will include the analysis of the statements of key regional stakeholders in the Political Administrative Region, as well as of texts produced by local newspapers as a way to access the points of view of emerging and informal actors. *Primary method:* Text research.

- **Socio-economic component**. The component will collect cross-country socio-economic quantitative data at the level of the Labour Market Area under examination. The component will be based on the existing model developed by IWH on structural change (see Para 3.4) and will provide inputs for the development of regional scenarios. *Primary method:* Data collection/Quantitative socio-economic model.

- **Socio-ecological and technical component**. This component research module will assess the presence of the different transformative capacities in the multilevel governance system associated with the Political Administrative Regions examined. The module will use regional key informants as sources of factual information referred to the presence of the different capacities in the region. Moreover, the method adopted will compare the assessment conducted by local stakeholders with the assessment of the researchers and investigate possible gaps. *Primary method:* Semi-structured in-depth interviews.

### *2.4.2 Methodological Juncture*

The juncture between these methods will be carefully defined in a later stage of the ENTRANCES project (WP2 – Methodological Framework). The conceptual framework has been developed looking at the feasibility of the envisaged modules altogether, considering the time and resource limits established by the project. Besides feasibility, other forms of juncture among the different modules will be set by a) better defining the secondary use of methods across the components/modules, and b) revising the sequence of methods to be applied so that the information collected through each method can be used as input for the following ones.

## 2.5 Synopsis

### 2.5.1 Added-value of the Multidimensional Analytic Framework (MAF)

In light of the three critical junctures presented above, **the added value of the Multidimensional Analytic Framework** (MAF) is clearly evident. On one side, the framework relies on the heuristic power of the five different approaches included, and so it should be capable of considering the complexity of the individual processes under examination in the different components. On the other side, the inclusion of the different components in a single framework would allow interpreting in each case what are the interactions – that otherwise would be invisible – among the phenomena highlighted by the different components. In other terms, the results of the analysis of each component are expected to support the interpretation of the other components, and more importantly, the junctures between all the components should provide a critical context for a holistic interpretation of each case as a whole.

### 2.5.2 Synoptic table

The features of the conceptual side of the Multidimensional Analytic Framework are summarised in the synoptic table reported below. For each of the analytical components the table presents:

- **The approach**, i.e., the established set of theories and methodologies adopted by each component
- **The domain of enquiry**, i.e., the "things" that each component studies, and/or the "things" that each component is capable of studying
- **The unit of analysis** i.e., specifies the territorial area about which each component is intended to provide insights
- **Unit of observation** i.e., specifies the object about which information is collected (to provide insights on the research area)
- **Primary method**, i.e., the method that will be prevalently adopted by that component and that therefore will be based on that specific component's research area.

**Table 4 - Synoptic table of the conceptual framework**

| Component | Approach | Domain of enquiry | Unit of analysis | Unit of observation | Primary method |
|---|---|---|---|---|---|
| **Socio-Cultural** | Socio-cultural Stress | Socio-cultural stress and strains present at the territorial level | Coal & Carbon territory | The territory as a whole | Focus groups |
| **Socio-Psychological** | Place attachment | Psychological stress, coping strategies and individual decisions to stay or leave | Coal & Carbon territory | Citizens in the territory | Survey |
| **Socio-Political** | Technological Drama | Narrative battles to determine the meaning and "appropriation" of technological change | Political Administrative Region | Discourses on the transition of C&C territory | Text research |
| **Socio-Economic** | Structural-change | Reallocation of economic activity across sectors and regions | Labour-Market Area | The area as a whole | Quantitative data collection |
| **Socio-Ecological & Technical** | Transformative capacities | System's actors, processes, and reflexive and relational dimensions | Political Administrative Region | Multilevel System interaction | Semi-structured interviews |

# 3 The Five Analytical Components

*The five analytical components are described in separate paragraphs below. The description of each component is an extract of the more extensive description provided in the five "short-reports" annexed to this report. For this reason, the component description reflects the different disciplinary and narrative styles of the different teams involved.*

## 3.1 Socio-cultural component

### *3.1.1 Approach and key concepts*

**Approach**

The socio-cultural component is based on the theory of the **stress-strain element of the social system** (Bertrand, 1963). Differently from other theories which interpret socio-cultural stress as the stress at the individual level produced by socio-cultural factors, the stress-strain theory is focused on the stress at the level of the social organisation (social structure). Therefore this theory can be applied to different societal, organisational, or institutional contexts or fields[7] (Bourdieu and Wacquant, 1992) which are characterised by "being structured".

The basic idea is that the social structure – i.e., the interconnected set of rules, habits, symbols, role models, routines that regulate and characterise a certain form of social organisation (or social field) – has contradictory needs: on the one side, it should be rigid enough to ensure stability to the field but, on the other side, it should also be flexible enough to allow for adjustments since not all the actors operating in the field share to the same extent the values, norms, rules that characterise it.

When conflictual or contradictory needs, ideas or processes arise within a certain organisation or field, **processes of disorganization could take place inducing stress on the social structure** which therefore necessitates some sort of adjustment (e.g., adjustments in terms of norms, rules, models, symbols, etc. or their configuration). For this reason, stress can be considered also as a pressure to change. At the same time, the theory explains the stability (or resiliency) of the social structure as it can tolerate a certain amount of stress.

The stress-strain theory can be used to study different types of institutional and organisational fields to explain their change and stability dynamics. In the project, the theory will be used to investigate the **stress-strain affecting the territorial milieu**, i.e., the structured set of actors and relations existing over a certain geographical area (Camagni, 1991). In this perspective, the socio-cultural component will focus on those stress-strains that may trigger deterritorialisation – the weakening of ties between a community and its territory – as well as reterritorialisation dynamics.

[7] A field can be understood as any historical, non-homogeneous social-spatial arena in which people maneuver and struggle in pursuit of desirable resources (Bourdieu and Wacquant, 1992)

**Stress-strains**. The theory is based on the **articulation of the "stress-strain" pair**. Stress is an element inherent to the social structure in a given institutional or organisational field, that cannot be observed per se but manifests itself in "strains" of different types such as conflicts, tensions, ambivalences, etc. Therefore, the "strains" can be interpreted also as the manifestation of the stress in action at the structural level.

**Stress factor**. A stress factor (or stressor) can be defined as a social process that has the potential to activate stress within the social structure. Stress factors vary over a wide range of characteristics: for their origins, which can be either from within or from outside; for intensity, as some pressure to change can be stronger than others; or for the duration, as some stress-strain can be temporary or contingent while other can be long-lasting in society. Moreover, strains are more visible in certain periods or a certain type of contexts. Finally, the activation of stress depends also on the coping strategy adopted to deal with the stress factor. An adequate coping strategy may reduce or even prevent the activation of stress-strains, while, in other cases, a certain coping strategy may trigger stress (secondary stressor).

**Stress accumulation**. It is worth to be noticed that, following this theory, all the forms of social aggregation are characterised by some degree of disorganisation, which produces constant adjustments, and therefore stress-strain can be considered a "physiological" condition of any social organisation or field. At the same time, the accumulation of different stressors (with high intensity and duration) may lead to outcomes different from adjustments, such as field ruptures or radical change.

### *3.1.2 Domain of enquiry*

The Socio-cultural component will look at the socio-cultural stress induced by globalisation at the level of the territorial organisation in coal and carbon-intensive regions. More specifically, the component investigates which are the socio-cultural stress factors affecting the territorial system and assesses to what extent such factors produce stress-strains in the concerned regions, thus allowing to identify a specific profile of socio-cultural stress for each of them.

The focus on globalisation-induced stress allows to include in the analysis a set of territorial transformations or reactions that are not strictly related to the energy transition, but that – similarly to what happens to other areas affected by deterritorialisation processes – can be constitutive of the challenges faced by coal and carbon-intensive regions. In this regard, the socio-cultural component balances and complements the other four components which are centred on the analysis of the decarbonisation process. Moreover, the focus on socio-cultural stress factors related to globalisation allows identifying processes and phenomena which are expected to have a long-lasting effect on the territorial organisation. This will be particularly important for producing insights useful for the elaboration of the transition policies which in most of the project cases should have medium and long term perspective.

The stress factors have been associated with the five types of global cultural flows (the five "scapes", Appadurai, 1990 and 1996):

- Ethnoscape, related to flows of people
- Technoscape, related to flows of technologies
- Financescape, related to financial flows
- Mediascape, related to flows of images and other cultural media
- Ideoscape, related to flows of ideologies (structured worldviews adopted by organised groups).

Moreover, we have used a term introduced by Sankaran and Nkengasong (2018) for considering the sixth type of “scape”:

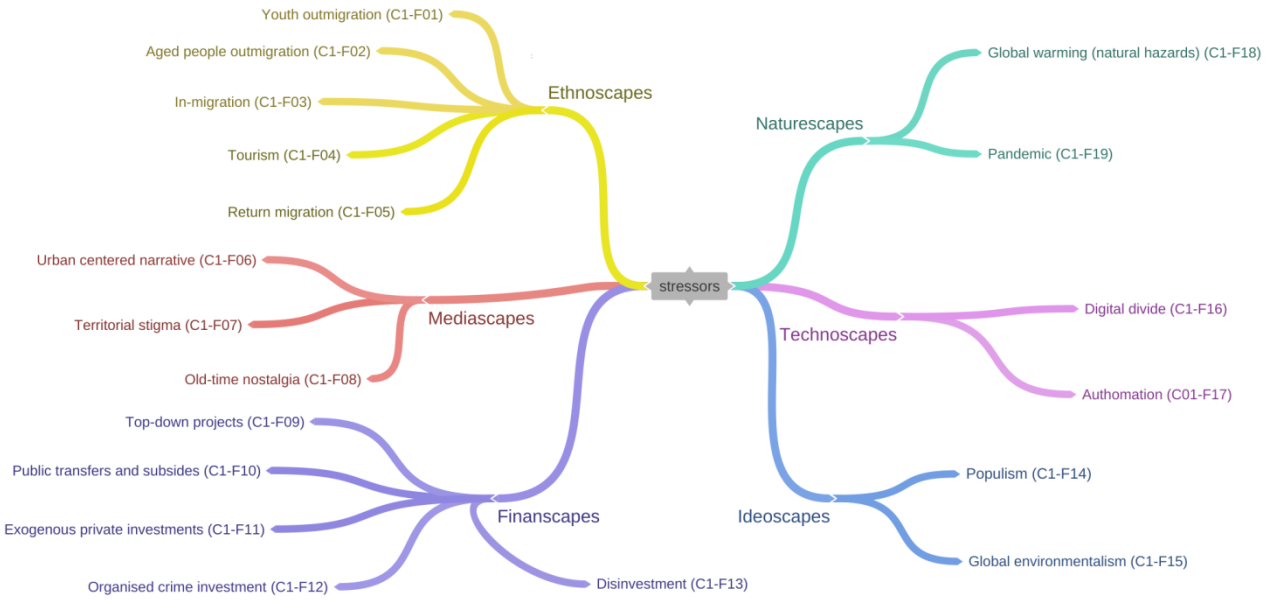
- Naturescape, related to the flows of non-human elements.

The different flows can be interpreted also as vectors of deterritorialisation, as they can lead to a weakening of the tie between a community and its inhabited space. The theory including six scapes has been adopted as a reference taxonomy for the identification and organisation of the stress factors included in the component.

### *3.1.3 Overview of the factors*

In total 19 socio-cultural stress factors will be investigated with this component. These factors have been organised across the six dimensions of global cultural flow as summarised in the picture below, which has been called the Socio-Cultural Stress Tree.

**Figure 4: The socio-cultural stress tree**




Each branch of the tree capitalises on the “empirical knowledge” contained in previous studies about stressors that plausibly can be in action in the cases considered by the project. The picture includes a set of selected heterogeneous phenomena, e.g., some of them are cognitive (old-time nostalgia) and some others are operational (youth outmigration). Notwithstanding that, their common rationale is that (a) all of them are connected with “flows of something”; (b) all these

factors can potentially produce socio-cultural stress on the territorial milieu, as all of them generate conflicts and/or tensions that put under pressure the territorial structure. In this sense, globalisation, in its different dimensions and expression, can be considered as a process that is putting under stress the territorial patterns of organisation, especially in those areas that have been "territorialised" based on functions or sectors that are loosening their key historical role in the current globalised environment.

While the socio-cultural stress tree is an original synthesis of the different factors that potentially can generate tensions and stress at the territorial level, a set of cautions should be formulated to better understand what is represented in the tree. A *first caution* in reading the Socio-Cultural Stress Tree is that the component will not study each of the factors in its intrinsic complexity, but rather, it will look at whether, how, and to what extent they are producing stress and strains at the territorial level. A *second caution* is that, albeit the tree provides a broad overview of the factors that plausibly are causing stress at the territorial level, it does not aim to provide an exhaustive list of all the possible socio-cultural stressors.

## 3.2 Socio-psychological component

### *3.2.1 Approach and key concepts*

The approach adopted merges a series of previous studies in a single framework encompassing the key approaches of i) place attachment, ii) resilience iii) and the Exit, Voice, Loyalty, and Neglect (EVLN) approach.

i) **Place attachment**. The concept of place attachment defines how people connect to various places, and the effects of such bonds in identity development, place-making, perception, and practice (Altman and Low 1992). It has been used by scholars to understand the bonds humans share with the physical environment and it is often explained in terms of its affective, cognitive, and conative elements (Scannel and Gifford, 2010). Leveraging on the integrated model of place attachment developed by Raymond (Raymond et al., 2010), which describes place attachment under different contextual dimensions, the project will articulate place attachment in four dimensions: a) place dependence, reflecting the functional dimension; b) place rootedness, reflecting the cognitive dimension; c) place identity, reflecting the symbolic dimension and d) social bondage, reflecting the emotional dimension.

ii) **Resilience**. The term resilience, in psychology, refers to positive adaptation in the face of stress or trauma (Luthar, Cicchetti, and Becker, 2000). In the socio-psychological component, the study of resilience will be used for achieving a more comprehensive understanding of the response adopted by individuals to the challenges faced by the citizens more directly exposed to decarbonisation in the coal and carbon-intensive regions in transition.

iii) **EVLN approach**. The possible copying strategies have been identified based on the "Exit, Voice, Loyalty, Neglect" (EVLN) model, initially proposed by Hirschman (1970) to study responses to decline in firms, organisation, and states (EVL theory), and later integrated by Rusbult and Zembrodt (1982) and many others. This model has been adopted in several different research

domains, including migration. The model affirms that when dissatisfaction is experienced in a relation (work relation, consumer-producer relation, territorial belonging, etc.) there are a few possible and interrelated responses from the individuals. The responses can be active or passive and constructive or destructive for the concerned relation.

- *Exit* refers to a coping strategy in which the dissatisfaction of the current situation leads to withdrawing from the relation and "move" elsewhere (active /destructive).

- *Voice* refers to any attempt to change, rather than escape from, the dissatisfying situation. It can include confrontational and defensive responses – i.e., recalcitrance to resistance (including any active form of opposition from complaint to violent protest) – but also more collaborative responses, such as those related to individual and collective reinvention (active/constructive).

- *Loyalty* is a strategy in which the response to the dissatisfaction of the current situation is just passively waiting for the situation to improve, without changing the status quo (someone else will take care of the problem) (passive/constructive).

- *Neglect* is a passive response that has negative consequences for the relation. For responding to the unsatisfactory situation, individuals start lessening efforts, giving less consideration to quality, detaching from the relationship. The Neglect response means passively allowing for conditions to worsen and it implies a progressive erosion of the relation (in our case with the territory). (passive / destructive).

### 3.2.2 Domain of enquiry

The socio-psychological component studies the socio-psychological impacts of the closure of coal-mines and carbon-intensive industrial units, i.e., the decarbonisation process, on the lives of individuals living in the Coal and Carbon Territory (CCT). The component moves under the assumption that the economic, social, and political uncertainties caused by the closure of mines and coal-based industrial units may be a strong source of stress, uncertainty, and internal conflicts for the local population, as it not only constitutes an existential threat to their way of life and their primary source of livelihood but also it may turn out in a dissatisfactory relationship with the territory.

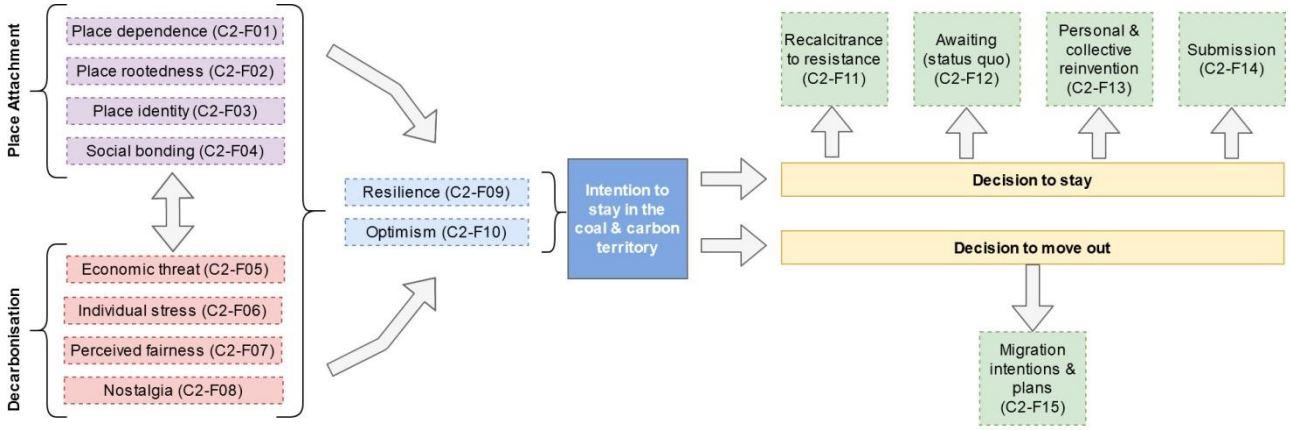
The component will investigate how place attachment is threatened by stress, uncertainties, and deprivation induced by the decarbonisation process, and what are the main coping strategies adopted by the citizens living in the different coal and carbon territories. The different coping strategies adopted will be investigated by distinguishing between those based on withdrawing from the territory – i.e., outmigration – and those implying for the citizens to stay in the region. Moreover, the different strategies adopted will be also interpreted considering that different degrees of individual resilience, can be found in the local population.

### 3.2.3 Overview of the factors

The factors of the socio-psychological component can be organised in a model where the different factors are the variables of the model. The model, which is represented in the picture below, can

be described as composed of different groups of factors related to place attachment (four factors, in violet), to decarbonisation impacts (four factors, in pink), to resilience (two factors, in blue) and the coping strategies (five factors, in green).

**Figure 5: Overview of the factors in the socio-psychological model**




Starting on the left, place attachment and Decarbonisation factors reflect how the two joint processes of deterritorialisation and de-carbonisation are being perceived by the citizens inhabiting the Coal and Carbon Territory (CCT). In both cases, some factors are related to the functional dimension (C2-F01, C2-F05), the cognitive dimension (C2-F02, C2-F06), the symbolic dimension (C2-F03, C2-F07), and the emotional dimension (C2-F04, C2-F08).

On the opposite side of the picture, there are the outcomes, i.e., the dependent variables, that the model tries to explain. The possible outcomes have been formalised in a set of five factors related to the coping strategies. These factors are divided between those related to the decision to move out (C2-F15) and those related to the decision to stay (from C2-F11 to C2-F14).

In the centre, Resilience (C2-F09 and C2-F10) acts as a “moderator” as individuals with high resilience are more able to cope positively with decarbonisation-induced stress. Resilience can also be understood in the model as a “filter” between the dynamics experienced by individuals (place attachment VS decarbonisation) and the different coping strategies, as different levels of resilience can orient individuals who experience the same dynamics toward different strategies.

## 3.3 Socio-political component

### *3.3.1 Approach and key concepts*

The component approaches politics as the way how are the people living and/or participating in different groups making decisions. In this regard, the decarbonisation process represents a significant challenge to the state of the affairs, since it is affecting not only the economy of a region, but challenges positions of different actors, influences the well-being of different people in a different way and, last but not least, accelerates many other processes and conflicts (e.g., shift to industry 4.0., demographic change). To analyse this process the component will rely on two theories: the local field of power, anchoring the analysis to the regional dimension, and the

technological dramas, offering an analytical framework to investigate the politics – technology nexus.

**Local fields of power**

The theoretical point of departure of this component is Bourdieu's notion of the **local field of power** (2005), which is a territorially-based and hierarchically-structured social space, where a pivotal structural weight invariably lies with those holding political and administrative power. Within this field, a long series of interactions and confrontations take place between social actors, who as a function of their position in objective structures of power, pursue diverse strategies. Leveraging on this theory, the component will consider decarbonisation at a regional level as a process encompassing often complicated shifts in local power, social positions, and economic benefits. Together with the influence of outside factors, a region facing transformation represents a complicated field in Bourdieu theoretical framework, where access to the benefits of decarbonization/transformation, or exclusion from the access to the benefits generated different political interests and positions on the transformation. In this regard, the socio-political component assumes that the interests, positions, and motivations of constituencies or stakeholders in the field inevitably differ.

**Technological Dramas**

Against this background, for analysing how the transition is modifying the local field of power, the socio-political component will rely on the theory of **Technological Dramas** (Pfaffenberger, 1992). This approach understands technological shifts – such as decarbonisation – as technological dramas, i.e., a narrative battle among different actors to determine the meaning and implications of the technology. A technological drama is a discourse of technological "statements" and "counterstatements", in which there are three recognisable processes: i) technological regularisation; ii) technological adjustment; iii) technological reconstitution. The three processes can be described as follows:

- through **technological regularisation,** a design constituency tries to impose change, i.e., to appropriate the technological process so that its features implicitly embodies the political aim of altering power relation

- through **technological adjustment,** the impact constituency – the people who lose when a new technology is introduced or when a technological shift is ongoing – engage in strategies that try to compensate for the loss of social prestige or social power

- through **technological reconstitution,** the impact constituency tries to reverse the meaning of the technology imposed through regularisation. Differently from technological adjustment strategies, the strategies related to technological reconstitution attack the foundation of technical regularisation, activate a self-conscious "revolutionary" ideology aimed at producing a symbolic inversion and antisignification of the technological regularisation process.

The component will rely on this theory to understand how these different processes are shaping the local field of power in the coal and carbon-intensive regions, in which a process for energy transition regularisation is ongoing.

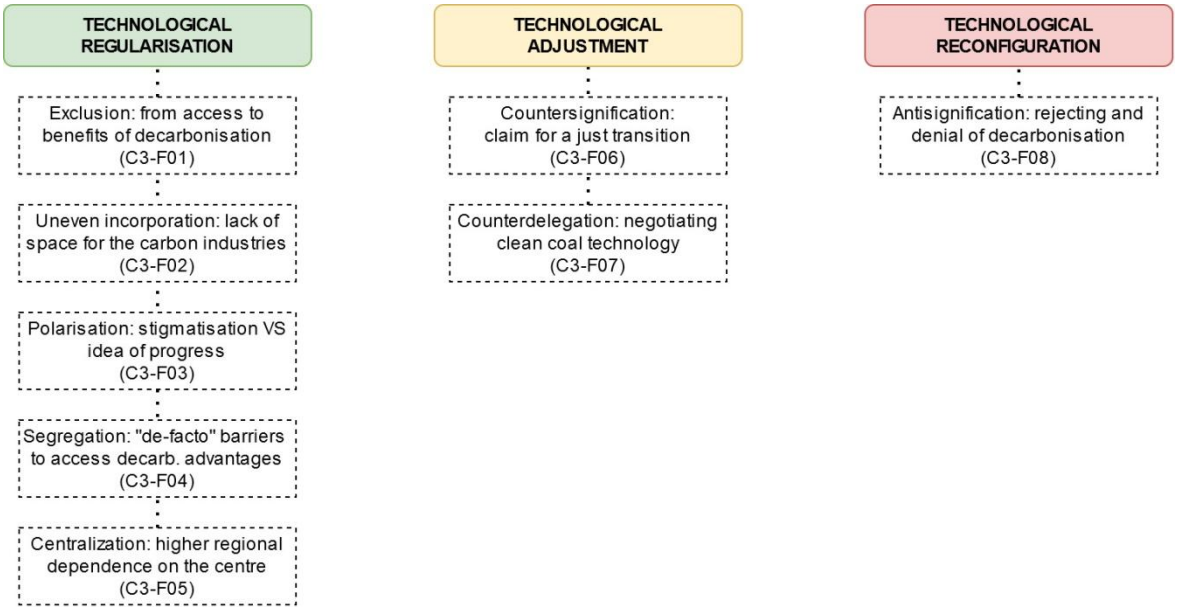
### 3.3.2 Domain of enquiry

The component will analyse the **socio-political narrative battles** on decarbonisation and energy transition in the coal and carbon-intensive regions to identify how different social processes – which are backed by different "constituencies" – are contributing to shaping the energy transition and modifying the local field of power. The analysis will allow identifying **which are the actors that are forming the constituencies** imposing the transition (backing technological regularisation), coping with the transition (backing technological regularisation), or opposing the transition (backing technological reconstitution), and how these different constituencies are reflected in the local field of power. Moreover, through analysing the "statements" and "counterstatement" of such actors, the component will investigate **how different constituencies understand benefits and losses** from the decarbonisation process and how they operationalise them. Finally, the component will investigate how the decarbonisation process in each region is influenced – also in terms of **obstacles and enablers** – by the interaction of the three processes of technological regularisation, adjustment, and reconstitution, as they operate in the same local field of power.

### 3.3.3 Overview of the factors

Following the theories reported above a set of eight factors have been identified, characterising the three processes of technological regularisation, technological adjustment, and technological reconfiguration. An overview of the factors is presented in the picture below.

**Figure 6: Overview of the factors in the socio-political component**



## 3.4 Socio-economic component

### 3.4.1 Approach and key concepts

**The socio-economic significance of the structural change**

The component moves from the observation that, in the general context of the energy transition, coal and carbon-intensive regions are facing a more substantial structural change than other regions, which rely less on coal or carbon-intensive industries. In previous structural changes, like the industrial revolution, the transformation from a secondary-industry economy to a tertiary-industry economy or the ongoing digitisation had multiple consequences for regions and industries. For instance, the industrial revolution led to increased use of coal as an energy source, but also a tremendous structural change of the economy. Workers formerly mainly employed in the agricultural sector found new jobs in the secondary sector. Further, the accelerated increase in the efficiency of the manufacturing and agricultural sectors led to a rise in the services sector. Salaries of workers in the mining and quarrying industry reflect the increasing efficiency. Further, the discovery of coal reserves and the outlook of high salaries lead to migration flows of young workers. The terms de/re-territorialisation can help to understand this change: in one sense rural labour-power was de-territorialised (peasant and landowner), but in another sense, it was re-territorialised (coal miners and factory owners) (Parr, 2010). A transition from coal and carbon-intensive industries to reduce greenhouse gas emissions has similar consequences. Additionally, the impact of structural change can differ across gender, e.g., resource shocks in male-dominated sectors can spill over to the rest of the economy (Aragon et al., 2018).

**Structural change analysis**

The focus of this component is on **structural change in the economy**, i.e., the reallocation of economic activity across different economic sectors (Herrendorf et al., 2014) and regions. Structural change can lead to a change in a region's economic, financial and demographic composition. Key concepts of structural change and economic growth concerning the clean energy transition will be adopted. The project will leverage on an approach already developed for assessing structural change at the regional level in Germany (Heinisch et al., 2020), which is a model that includes energy and non-energy production sectors, regional consumption, regional incomes, labour market dynamics, fiscal transfers between regions, price adjustments and migration. To do that, the model analyses the economic effects of a coal and carbon phase-out through the lens of a Dynamic General Equilibrium model (DGE) with multiple sectors and regions. In the Multidimensional Analytic Framework, the input data of the model will be used to provide the current portrait of the different case study regions, while in a later stage of the project[8], the model will be used to simulate coal and carbon phase-out and to formulate different scenarios for the individual regions and overall.

[8] The production of scenarios will be conducted in the part of the project dedicated to knowledge integration and policy recommendations (WP6).

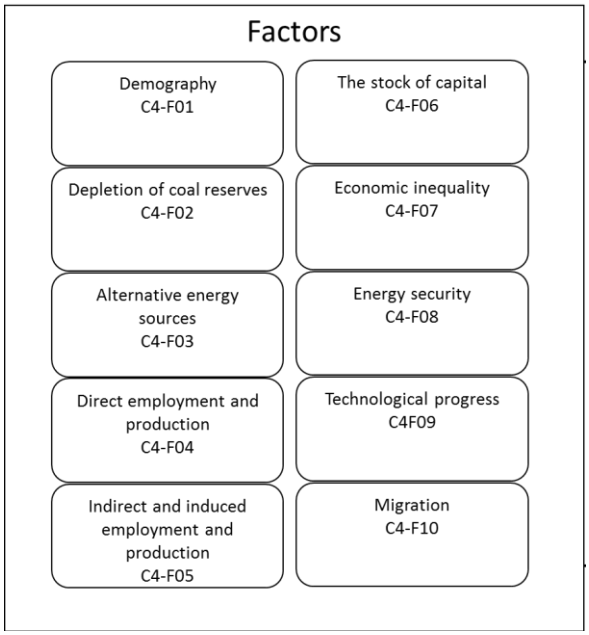
### 3.4.2 Domain of enquiry

The socio-economic component will analyse the potential impact of the energy transition on labour markets and the economic development in the affected regions. In this regard, the component will more specifically focus on the impact of the transformation on the labour market in the specific regions and the overall economic activity. The main indicators of interest are unemployment rates, gross domestic product, migration, and labour income.

### 3.4.3 Overview of the factors

In the socio-economic component, ten different factors have been taken into consideration. All the factors will be investigated mainly from a quantitative perspective. An overview of the factors to be considered is reported in the table below.

**Figure 7 - Overview of the factors considered in the socio-economic component**




## 3.5 Socio-ecological & technical component

### 3.5.1 Approach and key concepts

**Socio-ecological and technical system (SETS)**

The socio-ecological and technical component leverages on research that seeks to understand stability and change in coupled socio-ecological systems (SES) and socio-technical systems (STS). These interdisciplinary fields of research are based on the premise that SES and STS are complex adaptive systems, which implies that they are characterised by emergence, self-organisation, co-evolution, and non-linearity. They do not change in a predictable, linear,

incremental fashion, but may abruptly switch into alternate regimes (either as a result of endogenous dynamics, or exogenous pressures) in which their function, structure, and feedbacks are different. These approaches offer a strong alternative to those that inadequately theorise sustainability in terms of independent sectors (economy, society, environment) with "underlying assumptions of reducibility, linear trade-offs or synergies and separability" (Reyers et al., 2018).

This systems approach has been usefully applied in SES to understand the dynamics of social-ecological systems and thus promote resilience-based adaptive management paradigms, as well as perspectives that seek to ensure a "safe [and just] operating-space for humanity" (Rockström et al., 2009), in which social needs can be met without overshooting planetary boundaries. It also finds a conceptual antecedent in the landmark *Limits to Growth* (Meadows et al., 1972) report, which first questioned the long-term sustainability of our current economic trajectory from a systems perspective. The socio-technical approach to sustainability transitions includes a range of interdisciplinary perspectives that consider the evolution and transformation of large-scale systems through which key societal needs are fulfilled (e.g., electricity, heat, mobility, agro-food). The cumulative lifecycle impacts of such systems contribute to between 70 and 80 percent of global environmental problems. The resolution of the problems brought about by unsustainable production and consumption patterns in these socio-technical systems comprise grand societal challenges, which cannot be addressed by incremental improvements and technological fixes, but require radical shifts to new kinds of socio-technical system. A central aim of sustainability transitions research is to conceptualise and explain how radical changes can occur in the way societal functions are fulfilled.

It is important to note that although the systems perspective is shared, the theory developed in each of the two approaches pertains to different kinds of system. SES draws inspiration from systems ecology, while STS draws on evolutionary economics, sociology of technology, and institutional theory to examine the evolution of socio-technical systems within what is ultimately a growth-based economic system. The SES perspective can shed light on the contradiction between such a system and the biosphere within which it is embedded. For instance, a systemic shift to biofuels can be analysed using the STS paradigm as a breakthrough in sustainable energy production, but it will be very differently viewed by an SES framework that may incorporate consideration of the impact of loss of land previously used for subsistence agriculture (and the associated famine), biodiversity loss associated with mono-crops, etc. Conversely, the STS framework might offer insight into how the dynamics of the socio-technical system led these social-ecological impacts to be ignored. In short, both approaches offer complementary insights into dimensions of the same phenomena. Accordingly, there is an infant body of work examining linked socio-ecological-technical system (SETS).

These frameworks have been relatively little applied to regional transitions, which provides an opportunity for this project to make an exciting theoretical contribution, examining spatial factors that affect transformative capacity in each case, as well as those pertaining to the type of transition being effectuated (which systems are being targeted by the decarbonisation effort). In any case, the core analytical puzzle for the socio-ecological and technical component, as stated by Geels (2011), "is to understand how environmental innovations emerge and how these can replace, transform or reconfigure existing systems".

Transformative capacity can be broadly defined as “the capacity to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable” (Walker, Holling, Carpenter and Kinzig, 2004). More specifically, it is understood here as the “type of power that effectuates deep and holistic [regional] change, resulting from particular forms of agency and interactions in a given institutional and spatial-material setting” (Wolfram et al., 2019). Transformative capacity “forms a qualitative and contingent measure of [regional] system dynamics describing a set of key parameters concerning actors, institutions, physical environs, and their interaction processes. As such it depicts an evolving collective ability to conceive of, prepare for, initiate, and perform path-deviant [regional] change” (ibid.).

The socio-ecological and technical component leverages on Wolfram’s (2016, 2018, 2019) Transformative Capacity framework, for **assessing the factors that are considered crucial for the transformation of a system**, be that social-ecological or socio-technical, or indeed coupled.

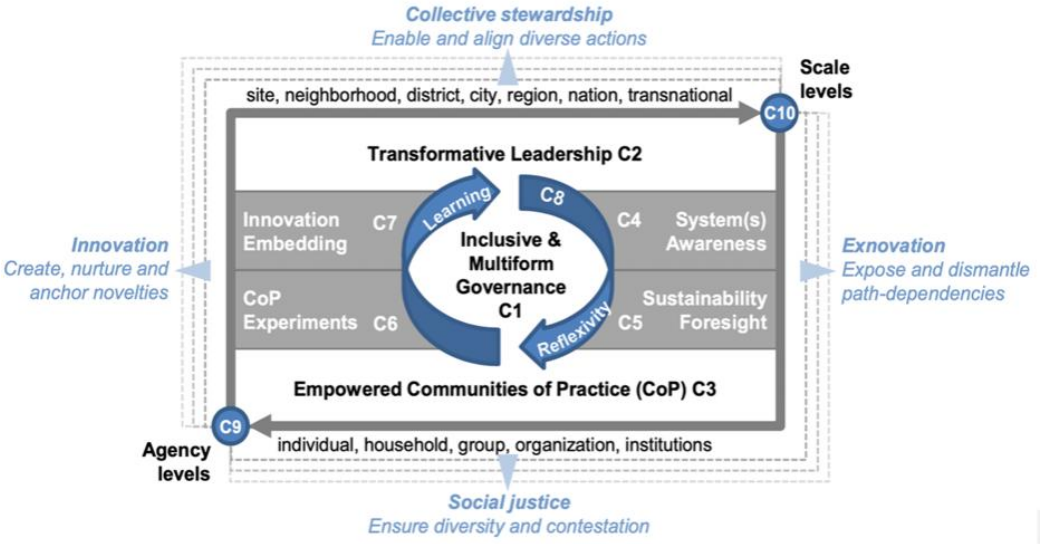
### *3.5.2 Domain of enquiry*

This joint component seeks to leverage the insights of socio-ecological and socio-technical systems thinking to assess the **transformative capacity available in case study regions**, focusing on the respective regional economic development system involved in shaping their decarbonisation pathways. In principle, different future decarbonisation pathways are always possible. The focus on transformative capacity allows us to discern how far a region is actually able to deviate from its current (carbon-intensive) path. This enables interpretations regarding (a) challenges faced and the utility of the coping strategies employed, (b) implications in terms of deterritorialisation, and (c) policy options driving reterritorialisation and transformative decarbonisation.

### *3.5.3 Overview of the factors*

A set of 10 factors, each related to one of the ten components of the transformative capacity identified by Wolfram (2016), will be investigated in the socio-ecological & technical component. The factors are represented in the picture below. Factors F01–F03 (in the picture C1-C3) refer to agency and interaction forms, F04–F08 (in the picture C04-C08) identify core development processes, and F09–F10 (in the picture C09-C10) represent relational dimensions that affect all other factors.

**Figure 8 – Overview of Transformative Capacity Factors (Source: Wolfram 2016)**




Transformative Capacity is strongly influenced by the governance of the regional decarbonisation/clean energy transitions in question. **Three governance components** are critical to the ability of a regional development apparatus to foster transformability of a system: the inclusiveness and multiformness of governance arrangements (F01); poly-centric and socially embedded transformative leadership (F02); and the empowerment and autonomy of relevant communities of practice (F03). These elements are preconditions for the transformability of a system: there needs to be connectivity and responsiveness built into governance, effective leadership able to bring people together around a vision, and actors empowered to experiment and innovate. These three attributes must be developed by stakeholders in **processes to enhance their transformative potential**, including enhancing understanding of the systems of which they are a part (F04), engaging in participatory visioning and alternative design scenarios (F05), experimenting with novel solutions to social needs (F06) and ensuring that these innovations can be embedded (F07). Ideally, this can be seen as a learning loop, where system understanding feeds into sustainability visioning, feeds into experimentation, feeds into embedding and better system understanding, but it can also be a lot messier. These **need to be fed back into governance**, though, by social learning (F08), and effective involvement of actors at different scales (F09) and levels of agency (F10).

# 4 Factors, Dynamics, and Patterns

## 4.1 Socio-cultural factors

### *4.1.1 List of socio-cultural factors*

#### *4.1.1.1 Ethnoscapes (flows of people)*

- **C1-F01: Youth Outmigration**. ► *Description*: Young peoples' decisions about where to settle and live are not only influenced by finding a job, but also by access to higher education, having a variety of career opportunities, a work-life balance, affordable housing, high quality of life, as well as a broad social and cultural infrastructure. Moreover, migration is also an escape from the societal constraints of the local place, as it represents an opportunity for finding freedom elsewhere. Youth migration causes negative consequences at the regional level: youth emigration is not only connected to the losses in productivity, human capital, and innovation (brain drain), but it also means that potential parents are leaving and therefore, lead to a decline in population. Youth outmigration contributes to creating tension with the implicit values of the territorial milieu, e.g., the regeneration of the bond with territory across generations. ► *Gender-sensitive*: Yes. ► *Key reference*: Pedersen and Gram, 2017. ► *Further reading*: Annex I, page 13.

- **C1-F02: Aged outmigration**. ► *Description*: With ageing and improved health and health care, mobility of the elderly and middle-aged people is on the rise. This type of migration can include many different trajectories, such as return retirement migration, as well as mobility of certain specialist workers, or parents leaving after their children. Older individuals move for economic as well as non-economic reasons. Aged migration represents a stress factor as it is a loss in the social texture and the historical and cultural memory of places. Moreover, it represents a loss of income in the region of origin. ► *Gender-sensitive*: Yes. ► *Key reference*: Zaiceva, 2014. ► *Further reading*: Annex I, page 14.

- **C1-F03: International immigration**. ► *Description*: Decreasing of birth-rate and outward migration are among the main factors of population decline in some regions. Such a decline can at least partially be mitigated by an increase of international immigrants in particular in shrinking rural areas, former industrial towns, or coal and carbon-intensive regions. In the very last years, this process has been fostered by the high number of refugees and asylum seekers in some European countries (e.g., Germany). The fast increase of immigrants in the regional population is certainly a socio-cultural stress factor, as it implies a fast change in the socio-cultural landscape of the area, and is often accompanied by tensions and even overt conflicts at the local level. ► *Gender-sensitive*: Yes. ► *Key reference*: Galera et al., 2018. ► *Further reading*: Annex I, page 15.

- **C1-F04: Return migration**. ► *Description*: The process of mass emigration is generally accompanied in time by return migration. Thus, those countries which have experienced an intense outmigration of nationals are generally exposed to a return to the homeland of those who left home. Similarly to the process of mass emigration, mass returns, could create a serious challenge for society and in the labour market. In this context, while return migration is

generally considered an opportunity to cope with regional depopulation and for dealing with a regional decline, recent studies in some European countries (e.g., Poland, Bulgaria, Albania, Greece) show that it can also generate strains at the territorial level both in the labour market – e.g., return migrant competing with residents – and at the cultural and social level. ► *Gender-sensitive*: Yes. ► *Key reference*: Duda-Mikulin, 2018. ► *Further reading*: Annex I, page 16.

- **C1-F05: Tourism**. ► *Description*: Tourism is generally considered an important sector for the economic development of de-industrialising areas and shrinking regions. Notwithstanding that, in the literature, a broad array of phenomena are associated with tourism as a socio-cultural stress factor at the territorial level. Tourism can trigger local price inflation, change of local cultural patterns for conforming to tourist culture, destruction or pollution of the local natural environment, outbreaks of epidemic diseases are more probable. ► *Gender-sensitive*: Yes. ► *Key reference*: Egbali and Bakhsh, 2011. ► *Further reading*: Annex I, page 17.

#### *4.1.1.2 Mediascapes (flows of images)*

- **C1-F06: Urban-centred narrative**. ► *Description*: In the last two decades a dominant narrative has put forward the idea that territorial interventions should not focus on declining places – as perceived to have a lower potential – but rather on those places that are supposed to be more rewarding (in terms of investments): large and dynamic cities. This led to creating a shared image of "places that matter" and "places that don't matter", in which the latter are often linked to crises in the agricultural and/or industrial sectors, to significant outward migration and brain drain. The diffusion of these images is a source of stress as it spreads a shared feeling of peripheralisation and a diffused lack of faith in the future of the territory. ► *Gender-sensitive*: No. ► *Key reference*: Rodriguez-Pose, 2018. ► *Further reading*: Annex I, page 18.

- **C1-F07: Territorial stigma**. ► *Description*: A "territorial stigma" or "environmental stigma" can be attached to some territory, for its economic, social, or environmental features. Territorial stigmatization is not a static condition or a neutral process, but a consequential and injurious form of action through collective representation fastened on a place. A territorial stigma is a form of socio-cultural stress as it influences the external relation of the region and also creates a sense of acceptance of unfavourable situations in the population and regional actors. ► *Gender-sensitive*: No. ► *Key reference*: Wacquant et al., 2014. ► *Further reading*: Annex I, page 19.

- **C1-F08: Old-time nostalgia**. ► *Description*: Nostalgia is generally mentioned as a sign of dysfunction within the wider political and governance system. It is also described as a contagious factor that is more likely to take hold in some places than others and can work as an "incubator" for "illiberal fantasies and political desires" (Kenny, 2017). This factor can take different shapes: golden era nostalgia, post-welfare melancholia, places nostalgia, etc. For coal and carbon regions specific terms have been produced like coal-fired nostalgia and smokestack nostalgia. Nostalgia can be considered a source of stress as the present territorial condition is persistently and negatively compared with a positively idealised past. ► *Gender-sensitive*: Yes. ► *Key reference*: Norocel et al., 2020. ► *Further reading*: Annex I, page 20.

#### *4.1.1.3 Financescapes (flows of money)*

- **C1-F09: Top-down exogenous development projects**. ► *Description*: Across Europe, one of the key coping strategies adopted to deal with the regions that are lagging, has been the adoption of top-down exogenous development strategies (e.g., creating growth/development poles). While in many cases these strategies have been a key for development, in some other cases, these coping strategies obtained results below the expectations and even became a factor of distress at the territorial level. Top-down exogenous approaches can lead to the design and implementation of big and eye-catching, but often superfluous development strategies, that can result in "white elephants" or "cathedrals in the deserts". These interventions can be a source of territorial stress as they may be not aligned with the local tradition and needs, they can be invasive of the built or natural environment, and can create social tensions among different interest groups. ► *Gender-sensitive*: Yes. ► *Key reference*: Rodriguez-Pose, 2018. ► *Further reading*: Annex I, page 21.

- **C1-F10: Public Transfer and Subsidies**. ► *Description:* National governments and European Union authorities often make resort to fund transfer and welfare state to mitigate the symptoms of economic and social decline. Among the measures more commonly adopted in these cases, are: (i) the creation of public employment as a way to improve the livelihoods of individuals and pump resources in the region; (ii) public transfers based on a progressive fiscal system, using funds for maintaining the welfare of disadvantaged areas; (iii) the supply of subsidies for disadvantaged people or economic activities. These mitigation measures can paradoxically constitute a further factor of stress on the territorial system as they have resulted in "assisted economies", incapable of mobilising their true social and economic potential as dependent on state and/or European fund transfers. The literature on the matter shows that when this modus operandi becomes deeply rooted in a territory, the sense that there are no future increases and make continuous assistance even more necessary. ► *Gender-sensitive*: Yes. ► *Key reference*: Rodriguez-Pose, 2018. ► *Further reading*: Annex I, page 22.

- **C1-F11: Exogenous private investments**. ► *Description:* Exogenous capital flows investment is generally seen as a desirable element for supporting employment and growth at the regional level. Nevertheless, such investments of privates or companies may create socio-cultural stress at the territorial level. Exogenous investment flows normally do not take into account the desirable patterns of development of the local community and the role that specific local culture may have as a mediator. Such limits have been highlighted by different strands of literature focusing on community-based development, exogenous development, smart villages, etc. ► *Gender-sensitive*: No. ► *Key reference*: Hess, 2018. ► *Further reading*: Annex I, page 23.

- **C1-F12: Organised crime investment and criminality**. ► *Description*: Organised crime investments spread across European regions, especially in areas and economic sectors that are in distress and where public funds are foreseen. Crime investments distort the local market, threaten the local social cohesion and are often accompanied by a feeling of insecurity. It has been registered in the literature as coal mining activity can be infiltrated by a criminal organisation. ► *Gender-sensitive*: Yes. ► *Key reference*: Mirenda et al., 2019. ► *Further reading*: Annex I, page 23.

- **C1-F13: Disinvestments**. ► *Description*: The disinvestment from fossil fuel can be referred either to: a) disinvestment campaign, conducted by environmentalist movements; and b) public disinvestment, adopted by regional, national, and European actors. In recent years, the coal extraction and coal power generation industries have been heavily hit by disinvestment. Besides the divestment from fossil fuels, private and public disinvestment in the regional economy happens also when the region registers a decline in the population and a reduction of its workforce as these are standard parameters adopted for assessing the productivity of regional investments. Example of stress strains provoked by disinvestments is the presence of unfinished infrastructure, building or facilities, interruption or sudden revision of regional development plans; business closure, size reduction or conversion. ► *Gender-sensitive*: No. ► *Key reference*: Bergman, 2018. ► *Further reading*: Annex I, page 24.

#### *4.1.1.4 Ideoscapes (flows of ideologies)*

- **C1-F14: So-called "populism"**. ► *Description*: The so-called populism is a political force that is spreading in Europe and worldwide. This so-called populism generally hinges on the figure of a charismatic leader, and it implies a declared intention to reverse global roles (deglobalisation). The spreading of populism has been particularly strong in territories that have suffered long-term decline or that are lagging behind, such as the areas experiencing decades of deindustrialisation and job losses. The so-called populism is reflected at the social level with different forms of strains including societal polarisation, violent protests, conflict over gender-friendly and LGBT-friendly policies, widespread resentment feelings, and anti-science attitudes. ► *Gender-sensitive*: Yes. ► *Key reference*: Rodriguez-Pose, 2018. ► *Further reading*: Annex I, page 25.

- **C1-F15: Global environmentalism**. ► *Description*: Globalism ideology is rooted in the concept of Global Commons and everyone's right to access them. This led to a new globalised environmental ideology, which in its moderate interpretation has become already an almost mainstream value on the global level. The climate crises have accelerated this trend and new forms of global environmentalism are spreading all around Europe and beyond (e.g., Fridays for future, Extinction Rebellion). Nevertheless, the spreading of global environmentalism can be a factor producing a set of tensions and conflicts also at the local level (e.g., intergenerational, local or site-specific conflicts). This is particularly true for coal and carbon-intensive regions, which are exposed to greater pressure for change. ► *Gender-sensitive*: No. ► *Key reference*: Barabanov and Savorskaya, 2018. ► *Further reading*: Annex I, page 26.

#### *4.1.1.5 Technoscapes (flows of technologies)*

- **C1-F16: Digital divide**. ► *Description*: The digitisation of the economy and social life put the peripheral or rural region in the position of disadvantage. From the supply side, these areas are more difficult to reach, and their reduced population (compared with other areas) makes the investment in these infrastructure low rewarding for the tech companies. On the demand side, peripheral areas suffer from a lack of skills and knowledge regarding digital technologies, which limits their possibilities for innovative service provision, business, or customer use. Therefore, rather than keeping on top of technological development, rural and peripheral areas are continuously in a situation of catching up with urban areas. ► *Gender-sensitive*: Yes. ► *Key reference*: Vironen and Kah, 2019. ► *Further reading*: Annex I, page 27.

- **C1-F17: Automation**. ► *Description:* There is strong evidence that digital technologies are resulting in greater divisions between large and small urban areas, and that future automation disruptions will further exacerbate regional and local disparities. Automation and mechanisation already challenge sectors like extraction, industries, agriculture, commerce, services. Such changes create a broad array of socio-cultural stress at the territorial level. Automation creates stress in the local labour-market, as implies the creation of scarcely regulated jobs, unstable and under-employment contracts, and conflicts over the control of digital data. ► *Gender-sensitive*: No. ► *Key reference*: Petropoulos et al., 2019. ► *Further reading*: Annex I, page 28.

#### *4.1.1.6 Naturescapes (flows of non-human elements)*

- **C1-F18: Global warming-induced natural hazards**. ► *Description:* Global warming, is causing more frequent environmental (and social) perturbations such as cyclones, floods, heatwaves, drought, and other natural hazards that, among others, alter the supply of water to mining sites and disrupting operations. In this regard, global warming produces stress not only at the individual level but also at the social and community levels. Examples of stress-strains are social disorder due to disasters, mistrust towards local authorities, widespread feeling of insecurity, business closure, or restrictions. ► *Gender-sensitive*: Yes. ► *Key reference*: Reyes-García et al., 2016. ► *Further reading*: Annex I, page 28.

- **C1-F19: Pandemic**. ► *Description:* The Pandemic is undoubtedly a form of socio-cultural stress at the territorial level. It has been highlighted that the pandemic can either accelerate and/or highlight some stress phenomena that were already present. It has been shown that the territorial consequences of the pandemic - included the socio-economic ones - are not the same everywhere and that a broad array of variable intervenes, such as the presence of more exposed economic sectors (e.g., tourism), the national responses to the emergency, the financial vulnerability of each local or sub-national government. Pandemic creates a wide range of stress-strains in the territorial organisation, including social conflicts on pandemics management, SMEs failures, creation of debts of local and regional authorities (decrease of revenues and increase of expenses at the local level), conflicts between different levels of governance. ► *Gender-sensitive*: Yes. ► *Key reference*: OECD, 2020. ► *Further reading*: Annex I, page 29.

### *4.1.2 Gender dimension in socio-cultural factors*

#### *4.1.2.1 Gender dimension in ethnoscapes*

Having multidimensional aspects, gender social norms are deeply entrenched within six “scapes” of the socio-cultural component. Straightforward and current examples are reflected in the ethnoscape and the naturescape cluster. Studies on migration using gender approaches show patterns, reasons, and impacts/consequences differ from women to men: young women tend to leave home earlier than young men, in rural and urban places alike (Jones, 2004), and they are more likely to migrate away from rural communities for education (McLaughlin et al., 2014) and more female-friendly labour markets. Jolly and Reeves (2005) point out that some gendered reasons to migrate are the possibility of income generation, family reunification, gender discrimination and norms, and forced migration (trafficking). Migration-related gender differences can be identified also in the host region or country, for example, disparities in the access to the

labor market that make migrant women more “likely to be over-represented in marginal, unregulated, and poorly paid jobs” (Piper, 2005: 2).

#### *4.1.2.2 Gender dimension in naturescapes*

Global warming and the increasing globalization intensify population movements, and the level of vulnerability tend to be much higher for women. They tend to have fewer opportunities to protect themselves in the short- and long-run, as they often have fewer financial resources and securities, less access to information and, sometimes, fewer networks. While women tend to be more affected by the negative impacts of global warming, they are less involved in decision-making for mitigation and adaptation measures and policies. Another graphic example is the covid-19 pandemic, which created new forms of vulnerabilities for women and their health and exacerbated social inequalities and disparities (Simba and Ngcobo, 2020). Nevertheless, women are also more aware of climate-related risks, and play a vital role in effective disaster risks governance and resilience (Hemachandra et al., 2018).

#### *4.1.2.3 Gender dimension in technoscapes*

Moreover, despite profound social changes, traditional and conservative gender norms are still present in many dimensions (Piasna and Drahokoupil, 2017). Studies exploring labour market issues from the perspective of digitisation shows that women still experience more disadvantages than men (Adebiyi, 2019).

## 4.2 Socio-psychological factors

### *4.2.1 List of socio-psychological factors*

#### *4.2.1.1 Place attachment*

- **C2-F01: Place dependence**. ► *Description:* Place dependence is conceptualized as the functional attachment to the place. Therefore, it reflects the importance of the place in providing features and conditions that support specific objectives or desirable activities. It highlights the role of physical environments in the attachment to the place, that is providing some comfort and the resources with the artificial and natural environment supporting a person's goals. The term dependence refers to the fact that the attachment to the place is caused by the place basic value in achieving the desired objective. ► *Gender-sensitive*: Yes. ► *Key reference:* Shumaker and Taylor, 1983. ► *Further reading*: Annex II, page 7.

- **C2-F02: Place rootedness**. ► *Description:* Place rootedness can be understood as a very strong and focused bond that ‘in its essence means being completely at home – that is, unreflectively secure and comfortable in a particular location’ (Tuan, 1980). Rootedness is an unconscious attachment to a place due to familiarity achieved through continuous residence – perhaps that of a familial lineage that has known this place in the years before the current resident. ► *Gender-sensitive*: Yes. ►*Key reference:* Tuan, 1980. ► *Further reading*: Annex II, page 8.

- **C2-F03: Place identity**. ► *Background:* The term 'Place identity' was introduced by environmental and social psychologists Proshansky et al., (1983), who explained it as a sub-structure of a person's self-identity, which consists of the knowledge and feelings developed through daily experiences of physical spaces► *Description:* Place-identity reflects the extent to which physical and symbolic aspects of the place contribute to one's sense of self or identity. A sense of place identity derives from the multiple ways in which place functions to provide a sense of belonging, construct meaning, foster attachments, and mediate change. ► *Gender-sensitive*: Yes. ► *Key reference:* Proshansky et al., 1983. ► *Further reading*: Annex II, page 9.

- **C2-F04: Social bonding**. ► *Description:* Social bonding is the feelings of belongingness or membership to a group of people, such as friends and family, as well as the emotional connections based on shared history, interests, or concerns. It is the degree to which an individual is integrated into society. It reflects the emotional dimension of place attachment. ► *Gender-sensitive*: Yes. ► *Key reference:* Hirschi, 1969. ► *Further reading*: Annex II, page 11.

#### *4.2.1.2 Decarbonisation impacts*

- **C2-F05: Perceived economic threat**. ► *Description:* Accumulated empirical evidence has mostly underlined the deleterious psychological effects, in terms of reduced psychological well-being of perceived economic threat in times of economic strain and uncertainty, as those that presumably characterise the Coal and Carbon intensive regions in transition. Economic threat motivates social-psychological responses to restore or maintain a sense of control and self-esteem, thwarted under conditions of personal or collective economic crisis. Depending on the circumstances such responses can be either “prosocial” or leading to out-group directed anger (especially when such threats are perceived also at a symbolic level). ► *Gender-sensitive*: Yes. ► *Main reference:* Fritsche and Jugert, 2017. ► *Further reading*: Annex II, page 12.

- **C2-F06: Psychological stress**. ► *Description:* Following Lazarus (1991) psychological stress is regarded as a relational concept, i.e., it is not defined as a specific kind of external stimulation nor a specific pattern of physiological, behavioural, or subjective reactions. Instead, stress is viewed as a relationship (transaction) between individuals and their environment. ‘Psychological stress refers to a relationship with the environment that the person appraises as significant for his or her wellbeing and in which the demands tax or exceed available coping resources. The changing relationship between individuals and their social and material environment in coal and carbon-intensive regions, under the effects of decarbonisation, has to be considered among the factors producing psychological stress. ► *Gender-sensitive*: Yes. ► *Main reference:* Lazarus, 1991. ► *Further reading*: Annex II, page 13.

- **C2-F07: Perceived fairness**. ► *Background:* ► *Description:* Perceptions of fairness refer to any element of the environment perceived by individuals or collectives as fair according to previous norms or standards (Peiró et al., 2014). Perceptions of fairness are associated with four elements: the rules and social norms governing how outcomes should be distributed (distributive justice), the procedures used for making such distribution decisions (procedural justice), how people are treated interpersonally (interpersonal justice), and how information is provided during the process (informational justice). The perceived distributive fairness is particularly relevant in terms of the energy transition in coal and carbon regions since the distribution of costs and benefits of this transition will affect different groups differently. ►

*Gender-sensitive*: Yes. ► *Main reference:* Peiró, et al., 2014. ► *Further reading*: Annex II, page 14.

- **C2-F08: Historical nostalgia**. ► *Description:* Recent literature has shown that nostalgia can be seen as a stabilising force, as it can increase social connectedness and enhance positive self-regard. Nevertheless, nostalgia has also been associated with the desire to escape into the imagined, idealized world of a prior era. This emotion represents a different, and independent type of nostalgia, which is called historical nostalgia. Historical nostalgia is often associated with a deep dissatisfaction with the present and a preference for the way things were long ago. ► *Gender-sensitive*: Yes. ► *Main reference:* Stern, 1992. ► *Further reading*: Annex II, page 16.

#### *4.2.1.3 General personal attitude and capacity*

- **C2-F09: Individual resilience**. ► *Description:* Resilience refers to positive adaptation in the face of stress or trauma. It is important to note that resilience is not only about overcoming a deeply stressful situation, but also coming out of the said situation with "competent functioning". In this regard, resiliency allows a person to rebound from adversity as a strengthened and more resourceful person. Resilience will be assessed as a key moderator of the decarbonisation-induced stress in the Coal and Carbon intensive regions. In this regard, individual resilience will be one of the filter variables of the model. ► *Gender-sensitive*: Yes. ►*Main reference:* Campbell-Sills et al., 2007). ► *Further reading*: Annex II, page 17.

- **C2-F10: Optimism**. ► *Description:* Optimism is a generalised tendency to expect positive outcomes or the belief that "good rather than bad things will happen in a person's life. Optimism reflects the belief that the outcomes of events or experiences will generally be positive. Optimists are likely to see the causes of failure or negative experiences as temporary rather than permanent, specific rather than global, and external rather than internal. Such a perspective enables optimists to more easily see the possibility of change. In the socio-psychological model adopted, optimism will be a "filter" variable as it can be conjectured that, all other conditions being equal (e.g., level of place attachment and perceived effects of deterritorialisation), individuals with different levels of optimism can pursue differentiated strategies. ► *Gender-sensitive*: Yes. ► *Main reference:* Aspinwall et al., 2001. ► *Further reading*: Annex II, page 18.

#### *4.2.1.4 Copying strategies*

- **C2-F11: Recalcitrance to resistance.** ► *Description:* Recalcitrance to resistance indicates an active reaction to change, even though a confrontational and defensive one. This reaction is activated when personal or collective identities are threatened by the ongoing change. Recalcitrance or resistance to the transition can include different behaviours, e.g., faint grumbling, filling formal grievance, engaging in counterproductive behaviours to get attention and force changes, participating in protest groups or even in violent protests. ► *Gender-sensitive*: Yes. ► *Main reference:* Hirschman, 1970. ► *Further reading*: Annex II, page 20.

- **C2-F12: Awaiting (status quo)**. ► *Description:* Awaiting is a strategy in which the response to the decarbonisation-induced impacts is just (passively) waiting for the situation to improve. Differently from other strategies (C2-F11) and (C2-F13), the individuals adopting this strategy

do not engage with changing the status quo, but rather assume that someone else will take care of the problem. ► *Gender-sensitive*: Yes. ► *Main reference:* Hirschman, 1970. ► *Further reading*: Annex II, page 21.

- **C2-F13: Personal and collective reinvention**. ► *Description:* This strategy represents an active and constructive response to the challenges of decarbonisation. Rather than opposing the ongoing change (see C2-F11), this strategy implies an attempt of the individual to positively adapt to the new situation (e.g., learning new skills) or to contribute to a collective reinvention (e.g., creating new occupational niches). The individuals adopting this strategy accept to change their identity for copying with the risks coming from the environment. ► *Gender-sensitive*: Yes. ►*Main reference:* Hirschman, 1970. ► *Further reading*: Annex II, page 21.

- **C2-F14: Submission.** ► *Description:* Submission is a passive response that progressively erodes the relationship between the individual and the territory. For responding to the unsatisfactory situation provoked by the transition ongoing in coal and carbon territory, the "submitted" individuals start lessening efforts, giving less consideration to quality, detaching from the relationship. ► *Gender-sensitive*: Yes. ► *Main reference:* Hirschman, 1970. ► *Further reading*: Annex II, page 22.

- **C2-F15: Migration intention or plan.** ► *Description:* This factor refers to a coping strategy in which the dissatisfaction of the current situation leads the individuals living in the coal and carbon territory to withdrawing from their relationship with the territory and "move" elsewhere. These factors may include both migration wish (e.g., discuss migration options with relatives) but also migration preparation (e.g., collects concrete information on where to migrate and how). ► *Gender-sensitive*: Yes. ► *Main reference:* Hirschman, 1970. ► *Further reading*: Annex II, page 19.

### *4.2.2 Gender dimension in socio-psychological component*

#### *4.2.2.1 Gender dimension pervades the socio-psychological component*

Socio-psychological factors might constitute the ENTRANCES' component that better allows the collection and analysis of gender-disaggregated data as they focus on individual responses to the uncertainties and challenges posed by the closure of mines and coal-based industrial units. Here, a gender-sensitive approach to psychological factors goes beyond gender-balanced sampling. It acknowledges gender as a central variable that, on the one hand, provides information about differences in interests, roles, and priorities between women and men and, on the other hand, might account for such differences, given that the social construction of gender influences individual's behaviour and emotional processes. For instance, women are more likely to develop and preserve social bonds in their residence area, which might be a major determinant of place attachment and identity (Tartaglia, 2006). Similarly, psychological studies have demonstrated that men and women exhibit different reactions and coping strategies when experiencing stress. For example, Matud (2004) states that women frequently report stress generated by the experiences of relatives (health issues), while men tend to report stress related to work and finances, and relationships with friends and lovers. Perhaps, some differences in the outcomes of women and men might be attributed to innately biological traits, but many others are rather the result of social gender expectations and roles.

#### 4.2.2.2 Gender strongly affects out-migration intentions

Gender is also a relevant variable when analyzing the impacts of this transition on the territory and the territorial and social identity of the regions. A straightforward example is the gender dimension of out-migration and consequent depopulation: according to the International Organization for Migration (IOM), both internal and external migration are gendered. Gender has effects on the reasons for migrating, the destination and the opportunities found there, and how people migrate.

## 4.3 Socio-political factors

### 4.3.1 List of socio-political factors

#### 4.3.1.1 Technological Regularisation

- **C3-F01: Exclusion from access to benefit of decarbonisation**. ► *Description:* Coal mining and carbon-intensive industries have been traditionally heavily dependent on large organized workforce often lower-skilled workers. On the one hand, harsh working conditions, pollution, three-shift operations, and health risks made these working positions unattractive. On the other hand, this type of industry provided job opportunities for otherwise marginalized ethnic minorities (such as Roma/Gypsies) and migrants who were otherwise disadvantaged in the labour market. The decline of the mining industry and/or traditional large and carbon-intensive enterprises are thus related to job losses, especially for ethnic minorities and migrants. These people are usually hired on the principle “last in - the first out”. The resulting unemployment may have strong ethnic connotations and is then presented in the public discourse as a result of individual failures (blaming the poor) combining with increasing populism blaming the minorities for local problems. ► *Gender-sensitive*: Yes. ► *Key reference:* Filcak and Jack, 2020. ► *Further reading*: Annex III, page 7.

- **C3-F02: Uneven incorporation: lack of space for carbon industries**. ► *Description:* Uneven incorporation in the decarbonization process is structured in a way that some groups are set aside and some are incorporated into it. The economic power of the carbon-intensive industries declines, they are not able to generate jobs and prosperity and their position as key stakeholders and the ruling class in local politics is gradually weakening on the account of strengthening the position of other economic sectors and other stakeholders. The declining of the carbon industry is reflected in falling support to the industry-backed political alliances and leaders in regional/local politics and increase of the new establishment affiliated with new businesses and services► *Gender-sensitive*: Yes. ► *Key reference:* Pfaffenberg, 1992; Filcak and Jack, 2020. ► *Further reading*: Annex III, page 9.

- **C3-F03: Polarisation: stigmatisation VS idea of progress**. ► *Description:* In technological regularization, a design constituency creates, appropriates, and modifies a technological artifact, activity, or system. It is projected into a spatially defined, discursively regulated social context, which is crucial to actualizing the technology's constructed social-political aims. Decarbonisation in this perspective is imposed by the design constituency as a dichotomy between “progress” and “backwardness”. In other words, supporters of the “old” industries are

stigmatised in the public discourse, leading to the discourse polarisation. The demographic change, perception of the fossil industry (as lacking long-term perspectives) and shift in coping strategies of younger generations further reinforce these dynamics. ► *Gender-sensitive*: Yes. ► *Key reference:* Pfaffenberg, 1992. ► *Further reading*: Annex III, page 11.

- **C3-F04: Segregation: "De-facto" barriers to access benefits of decarbonisation**. ► *Description:* The access to new sectors that are supposed to replace coal mining and other carbon-intensive industries is in principle open to all, but since there are technological, regulatory or economic barriers to access them, only a few can access them. In this regard, decarbonisation is followed up by the rise in IT technologies, which are becoming at the gist of economic development. However, some stakeholders are excluded in the use of these technologies, given their place in the system of hierarchies. These groups can be low-income households (lack of access to PCs or internet connection, low education, and skills), these can be small entrepreneurs (lack of capital to invest in computerisation of their business), under-funded public institutions such as schools. Moreover, often coal and carbon regions cannot compete in the digital economy as they often suffer the digital divide compared with other more central or urbanised areas. In the energy sector, it was observed that the policies for achieving the emission reduction objectives – based on incentives and support schemes – often have not favored the internal production chain, leading to the import of technological components without the development of local specialized companies ► *Gender-sensitive*: Yes. ► *Key reference:* Pfaffenberg, 1992; De Luca et al., 2020. ► *Further reading*: Annex III, page 13.

- **C3-F05: Centralisation**: **Higher regional dependence on the centre**. ► *Description:* Negotiating power of centralised fossil industries is comparatively higher when it comes to various forms of subsidies and regulations by the central government. In aftermath of decarbonisation, many regions became more dependent on the centre than before. A decentralised local economy with its bases in small and medium enterprises requires diversified support. Governments overwhelmingly control technologies supply and use as well as form economic regulations and access to social benefits. Paradoxically, after the phasing out of heavy industries, regions are increasingly dependent in economic terms on central regulations and stimuli, e.g., governmental grants and compensations or fiscal instruments (e.g., tax bonuses). Moreover, access to the technologies and their benefits is in principle open to all, but the system is constructed so that users have little autonomy and significant decisions are reserved for central governments. ► *Gender-sensitive*: No. ► *Key reference:* Pfaffenberg, 1992. ► *Further reading*: Annex III, page 14.

#### *4.3.1.2 Technological Adjustment*

- **C3-F06: Countersignification**: **claim for a just transition**. ► *Description:* In technological adjustment, impact constituencies actively negotiate new meanings for the technological production processes, trying to orient changes, which are viewed as undermining their position and wellbeing, toward more fair and favourable outcomes. Traditionally, the main opposition to decarbonization processes found among the employees of the mines and carbon-intensive enterprises and its concern, that it brings labouring populations into the lower-class sectors and spaces of relatively wealthy societies. Hence the claim for a just transition has raised starting from the trade unions, and in three decades has found its place in global discourses related to climate policies. This factor focuses on the claim for a just transition at the local level, as there is a tension between "local just transition" and "planetary just transition". The claim for a local

just transition is a negotiation strategy that can be adopted, besides trade unions and workers, also by other stakeholders and societal actors. ► *Gender-sensitive*: No. ► *Key reference:* Stevis and Felli, 2020. ► *Further reading*: Annex III, page 16.

- **C3-F07: Counterdelegation**: **negotiation clean coal/carbon technologies**. ► *Description:* Counterdelegation is an adjustment strategy that negotiates a "small scale" modification of technology, as opposed to the deep and large-scale change proposed by technological regularisation. In the case of decarbonisation of coal and carbon-intensive regions examples of counterdelegation can be the attempt to negotiate clean coal or carbon capture and storage technologies to avoid the coal phase-out. The discursive strategies to garnish support for carbon capture and storage often claim that, since fossil fuel dependency cannot be reduced in the near future, sustainable ways of using coal must be developed and diffused. ► *Gender-sensitive*: No. ► *Key reference:* Trencher et al., 2019. ► *Further reading*: Annex III, page 17.

#### *4.3.1.3 Technological Reconstitution*

- **C3-F08: Antisignification**: **rejecting and denial of decarbonisation**. ► *Description:* The antisignification may arise as a reaction to regularization, polarization, and stigmatization in the public discourse on decarbonization. People whose status is invidiously affected by decarbonisation choose from a variety of potential responses. Beyond passivity, apathy, and resignation, they may attempt antisignification, in which they covertly substitute a myth or root paradigm that contradicts the mythos of transformation. It may have a form of presenting decarbonization as a concept from the "outside" (e.g., imposed on us by the EU and/or detached elites or people with vested interests benefiting from RE). Decarbonization is in this narrative presented as irresponsible, costly and basically as a misleading process with vested interests. Antisignification is an act of mythos substitution that decomposes and re-historicizes the meanings embodied in decarbonisation and may embody inclination to conspiracy theories, climate change denial, and support of populism in politics. ► *Gender-sensitive*: Yes. ► *Key reference:* Trencher et al., 2019. ► *Further reading*: Annex III, page 18.

### *4.3.2 Gender dimension in the socio-political component*

#### *4.3.2.1 Underrepresentation of women in the politics of transition (despite high stakes)*

Political systems may be seen as "any persistent pattern of human relationships that involves, to a significant extent, control, influence, power or authority" Dahl (1984, 9–10) and as fundamental to distributions, as in 'who gets what, where, when and how' (Celis et al., 2013). While the exclusion of women and female perspectives and needs in the public sphere cannot be seen as universal, there is still a lack of women in positions of leadership in political decision-making and economic affairs in the investigated ENTRANCES regions, leading to an overrepresentation of men and profound gender blind policies. In particular, in the energy sector, the underrepresentation of women is often higher than in other sectors of the economy as both in the public sector (ministries and parliamentary committees) and in the private sector (energy companies and industry associations) the top positions involved in energy-related decision-making are still male prerogative in many countries (IEA, 2019).

For instance, while it is widely known that mainly men are employed in the coal and carbon-intensive industries, it often remains unrecognised that resource shocks specific to men, can

create negative spill-overs to female workers in the rest of the economy (Aragon et al., 2018). More specifically, depending on the region, some women are substituted for men in the service sector (Aragon et al., 2018), others face the double burden of new productive work in addition to their reproductive work to substitute lost income from mine closures where care services are not in place or affordable (Aung and Strambo, 2020), and Bennett (Bennett et al., 2020) found that the overall females' relative share of household earnings declines by 6% after a negative resource shock. Consequently, there is evidence that the impacts of decarbonisation are gendered, which means that policies and benefit schemes for people affected by decarbonisation also need to be gender-sensitive to avoid exacerbating existing inequalities. Individual or collective power in the labour market is, however, not only linked to better job opportunities but also political influence (Aragon et al., 2018). Particularly, unions of the carbon industry used to have a powerful stand in political decision-making – unions in which women are generally underrepresented due to several cultural and structural constraints.

#### *4.3.2.2 Gender-polarised transition politics*

Current polarization regarding decarbonisation might also be understood as a clash between gendered habitus. The mining industry and former coal mining supporters and stakeholders, such as workers, trade unions, and politicians are strongly associated with a certain male "habitus", characterized by toughness, physical strength, and control. Yet, increasing awareness about gender and diversity has rendered the discourse of traditional masculinity as 'backward-looking'. Supporters of decarbonisation and environmental movements on the other hand have a younger and female image, which is considered progressive, also because they are perceived as performing new forms of femininity and masculinity, are gender-inclusive and diverse. On average more women than men are aware of climate change, perceive it as a risk, behave more environmentally friendly (Ugarte et al., 2016), are often more sustainable consumers (EIGE, 2016), are engaged in climate-related voluntary work and movements, and increasingly raise their voice for justice. This clash between gendered habitus is also seen in the gender voting gap – on average more men advocate for centre-right / right / far-right parties and values (Spierings and Zaslove, 2017), potentially due to men voting for more traditional values that might be perceived as backwards from a female or non-binary perspective. Gender patterns are interwoven into the carbon coal discourse, playing a role on an implicit, subtle level. Ignoring such patterns might exacerbate the conflict

## 4.4 Socio-economic factors

### *4.4.1 List of socio-economic factors*

- **C4-F01: Demography**. ► *Description:* Demographic change is a common phenomenon in Europe. Economic prosperity and better health care systems lead to an increase in life expectancy. At the same time, fertility rates in European countries declined, leading to a lower share of young people — regions in economic decline experience also greater out-migration of young cohorts. ► *Gender-sensitive*: Yes. ► *Key reference:* Oei et al., 2020. ► *Further reading*: Annex IV, page 8.

- **C4-F02: Depletion of coal reserves**. ► *Description:* Remaining reserves in developed countries are less accessible than the former ones. It implies higher mining costs and therefore, higher prices to achieve similar profits. One of the key drivers of the coal transition is the depletion of coal reserves. ► *Gender-sensitive*: No. ► *Key reference:* Galgóczi, 2019. ► *Further reading*: Annex IV, page 9.

- **C4-F03: Alternative energy sources**. ► *Description:* Coal, as an energy source, faces more competition from other energy sources, such as natural gas or renewables. These energy sources become cheaper and therefore crowd out coal as an energy source. Further, domestic coal production in Europe is more expensive compared to Russia, South Africa, or Australia. Low transportation costs of imported coal lead to a decline in domestic coal consumption. ► *Gender-sensitive*: No. ► *Key reference:* Galgóczi, 2019. ► *Further reading*: Annex IV, page 9.

- **C4-F04: Direct Employment and Production**. ► *Description:* Direct employment effects are changes in the number of workers in the coal and carbon-intensive industry. For instance, a reduction of demand for domestic coal reduces coal production and can reduce the demand for workers in coal mines and power plants. Further, an increase in the automation of coal mining can also reduce the demand for the production factor labour and simultaneously increase production. ► *Gender-sensitive*: Yes. ► *Key reference:* Galgóczi, 2019. ► *Further reading*: Annex IV, page 10.

- **C4-F05: Indirect, Induced Employment and Production**. ► *Description:* Indirect employment effects are changes in the number of workers at the suppliers for the coal and carbon-intensive industry. For instance, a lower output for the coal industry requires less input as well. Therefore, the demand for purchased machines and maintenance services falls as well. The impact on the regions depends on the industrial networks and the dependency of other industries on the coal industry. In addition to the supply chain linkages of industries and firms, the reduction in labour income can reduce consumption expenditure. Reduced consumption expenditure eventually reduces the demand for other products and therefore initiates direct and indirect effects in other sectors. Induced employment and production effects are the results of lower demand as a consequence of lower income in the directly and indirectly affected sectors. ► *Gender-sensitive*: Yes. ► *Key reference:* Galgóczi, 2019. ► *Further reading*: Annex IV, page 11.

- **C4-F06: Stock of Capital**. ► *Description:* The carbon-intensive industries increase the concentration of GHG in the atmosphere. But the mining of coal destroys the local environment. Further, it is not only the destruction of farming land or forests but also the relocation of towns and villages. Therefore, the coal mining process has direct implications for the available natural and physical capital stock. Further, the coal and carbon-intensive industries are important sources of tax revenues. Local tax revenues finance public infrastructure. A decline increases the dependency on fiscal transfers from other regions to maintain the public capital stock. ► *Gender-sensitive*: No. ► *Key reference:* Oei et al., 2019) please check. ► *Further reading*: Annex IV, page 11.

- **C4-F07: Economic inequality**. ► *Description:* Economic inequality refers to the phenomenon of an uneven distribution of income or wealth. Coal miners and workers in the carbon-intensive industry receive above-average wages and therefore have higher incomes compared to other

workers. It leads to economic inequality concerning labour income. ► *Gender-sensitive*: Yes. ► *Key reference:* Oei et al., 2019. ► *Further reading*: Annex IV, page 12.

- **C4-F08: Energy security**. ► *Description:* Energy security depends on a reliable supply of electricity and heat. Fossil fuels are the most important energy source for Europe. Renewable energy sources are mainly intermittent and therefore, less reliable. So far, it is not possible to run the electricity grid using only renewables. Energy storage facilities are required to compensate for the loss in reliable energy sources. Coal power plants need more time than gas-fired power plants until they can supply electricity. To maintain energy security, a fuel switch from coal to gas seems likely. ► *Gender-sensitive*: No. ► *Key reference:* Brauers and Oei, 2020. ► *Further reading*: Annex IV, page 13.

- **C4-F09: Technological progress**. ► *Description:* Technological progress is a long-run trend, which describes the ability to produce more output for a given number of production factors. The history of the coal industry in Europe shows a dramatic increase in labour productivity, measured as mined coal in tonnes concerning employment in the sector. This shift in demand for production factors leads to the creation of companies supplying the machines to the coal companies. Further, it allows increasing the total quantity of mined coal such that the price of coal and electricity fell dramatically. ► *Gender-sensitive*: No. ► *Key reference:* Brauers and Oei, 2020. ► *Further reading*: Annex IV, page 14.

- **C4-F10: Migration**. ► *Description:* Migration is a response to changes in the environment. In modern economies, migration is essential to balance our demand and supply on the labour market. For instance, some of the coal regions have been sparsely populated before the discovery of the different applications of coal. In the last decades, the role of the coal industry as an employer decreased. Young cohorts started to out-migrate again. ► *Gender-sensitive*: Yes. ► *Key reference:* Strambo, et al., 2019. ► *Further reading*: Annex IV, page 14.

### *4.4.2 Gender dimension in the socio-economic component*

#### *4.4.2.1 Gender-specific effects of decarbonisation in the labour market*

A coal phase-out and transformation of carbon-intensive industries has significant impacts on a society and its wellbeing. To investigate these impacts, a gender and intersectional perspective need to ensure the inclusion of all groups of society, avoiding the replication or exacerbation of existing injustices and vulnerabilities that may be transferred into new energy regimes (Johnson et al., 2020). While negative effects might be particularly felt by current or former employees of the coal and carbon-intensive industries that are mainly male-dominated, resource shocks, specific to men, may also create negative spill-overs to female workers in the rest of the economy (Aragon et al., 2018). Understanding those gender-specific effects in the labour market is essential, considering that women's relative labour opportunities are linked to a host of other outcomes, such as their political influence, fertility and children's well-being (Del Bono et al., 2012), as well as their intra-household bargaining power since intra-household violence rates against women, tend to increase with increasing gender wage gaps (Aizer, 2010).

#### *4.4.2.2 Hidden economic inequalities*

While the reduction of the gender pay gaps during negative resource shocks may be seen as a positive trend towards gender equality, the reduction is merely due to reduced average wages (Bennett et al., 2020). Bennett finds that the overall females' relative share of household earnings declines by 6% after a negative resource shock. Furthermore, when other jobs are available, care-givers (often women) have to be involved in both reproductive and productive work to substitute lost income from mine closures. While Shermann (2009) shows that this is an opportunity for changing gender perspectives and roles towards higher independence and self-esteem of women, other studies (e.g., Aung and Strambo, 2020) argue that additional work might not always be voluntarily and create an additional burden if there are no public and affordable care structures in place.

#### *4.4.2.3 Gender-related demographic impacts of decarbonisation*

Changing labour markets also impact migration patterns. Thus, in the UK mine closures led to a drop in the share of women in the region and an increase in the share of single, unmarried, individuals with a knock-on effect on reproduction in the area, reshaping demographic trends (Aragon et al., 2018).

#### *4.4.2.4 The weak position of women in new sustainable industries*

However, the energy transition is also an opportunity for new and sustainable industries. While the renewable energy sector attracts more women compared to the fossil fuel industries (IRENA, 2019)[9], female employees are still the minority and work mainly in administrative and low-paid jobs (Clancy and Feenstra, 2019). Also, decentralised renewable energy approaches, which are more democratic and participatory, such as energy cooperatives, are still male-dominated.

#### *4.4.2.5 Gender perspective and structural change analysis*

Considering gender perspectives in the socio-economic dimension will make pre-existing power dynamics and inequalities more visible to design policies and measures that create a just and sustainable energy transition. It offers opportunities for economic and structural change which are likely to benefit all genders while boosting the energy transition (Clancy and Feenstra, 2019).

[9] The female underrepresentation is less evident in the renewable energy sector where female workforce is equal to 32% with respect to the traditional fossil based companies in which it is equal to 22% (IRENA, 2019).

## 4.5 Socio-ecological & technical factors

### 4.5.1 List of socio-ecological & technical factors

#### 4.5.1.1 Actors

- **C5-F1: Inclusive and multiform governance**. ► *Description:* Governance is key to transformative capacity. Diversified, flexible, and robust governance structures are necessary for establishing the legitimacy, trust, knowledge, and political leverage needed for transformations (Wolfram, 2016). This factor can be broken down into three critical sub-factors: 1) Wide participation and active inclusion of stakeholders from all sectors; 2) Diversity of governance modes and actor networks (de-/centralised, formal/informal, multi-level, etc.); 3) Sustained and effective intermediary organisations and individuals between sectors and domains (hybridisation). ► *Gender-sensitive*: Yes. ► *Key reference:* Wolfram, 2016. ► *Further reading*: Annex V, page 10.

- **C5-F2: Transformative leadership**. ► *Description:* Transformations demand particular forms and attributes of leadership that enhance individuals' vital role as change agents. In particular, leadership needs to be polycentric and socially embedded, arising not only from political elites but also from many other issue-driven and/or place-based communities in society. Beyond commitment, its contribution should especially imply the translation between discourses (across sectors, domains, scales) and the articulation of new visions and discourses embracing sustainability, as well as various personal abilities that leverage collective energies and enable social learning. ► *Gender-sensitive*: Yes. ► *Key reference:* Wolfram, 2016. ► *Further reading*: Annex V, page 11.

- **C5-F3: Empowered and autonomous communities of practice**. ► *Description:* Meeting social need is a cornerstone of both capacity development and sustainability. This reflects an ethical dimension (intra- and intergenerational equity), as well as the recognition of human agency as the key to balance long-term ecosystem health and economic welfare. Social learning networks formed through the shared experience of place and/or wider joint concerns are decisive for identifying and articulating unmet social needs and formulating responses. Therefore, such 'communities of practice' require association, coalition forming, access to resources, and conditions of autonomy ► *Gender-sensitive*: Yes. ► *Key reference:* Wolfram, 2016. ► *Further reading*: Annex V, page 13.

#### 4.5.1.2 Processes

- **C5-F4: System(s) awareness and memory**. ► *Description:* Transformative change presupposes awareness and understanding among stakeholders of the system dynamics, path dependencies, and obduracies that undermine sustainability. Collective analysis capabilities and routines thus need to be developed to foreground linkages between cultures, structures, and practices in different cross-scale SES and STS. The focus should be on meeting social needs and creating widely shared system knowledge and memory to explain and anticipate performance, and inform (collective) agency and capacity development processes.► *Gender-sensitive*: No. ► *Key reference:* Wolfram, 2016. ► *Further reading*: Annex V, page 14.

- **C5-F5: Sustainability foresight**. ► *Description:* Future pathways linked to sustainability raise diverse normative questions and feasibility issues that require clarification and negotiation among urban stakeholders in order to create actionable policies, plans and projects. Beyond a system baseline and account for critical obduracies (C5-F04), target knowledge and transformational knowledge thus have to be developed through transdisciplinary co-production. To provide orientation at different agency levels (C5-F01 - C5-F03), foresight should create a collective vision of radical departure from the current path, as well as alternative scenarios based on system thinking. ► *Gender-sensitive*: Yes. ► *Key reference:* Wolfram, 2016. ► *Further reading*: Annex V, page 16.

- **C5-F6: Diverse community-based experimentation with disruptive solutions**. ► *Description:* Practical experimentation offers a crucial mechanism to develop transformative knowledge and catalyse social learning. Its systemic effects can be enhanced if experiments are guided by a collective vision (C5–F05), embedded by place-based and/or issue-driven communities of practice (C5–F03), and embracing holistic innovation (cultures, structures, practices — C5–F04). Most importantly, wider impacts depend on the degree to which such experiments are equally path-deviant, thus seeking to fundamentally rebalance long-term social, ecological, and economic development. ► *Gender-sensitive*: Yes. ► *Key reference:* Wolfram, 2016. ► *Further reading*: Annex V, page 18.

- **C5-F7: Innovation embedding and coupling**. ► *Description:* All the factors in this component presuppose that stakeholders share and/or enable access to basic resources for the purpose of developing capacity, starting from the people involved and locations for meetings — but increasingly also financial and material resources for practical transformation. The extent to which this is facilitated by gradually removing barriers to innovative practices and embedding them into routines, organizations, plans, and especially legal frameworks, is thus a critical capacity factor that needs to carefully attend practicability issues to effectively enable uptake and mainstreaming. It can be further enhanced by coupling different innovations into alternative pathways, as well as by practical approaches to building-related actor coalitions. ► *Gender-sensitive*: Yes. ► *Key reference:* Wolfram, 2016. ► *Further reading*: Annex V, page 19.

#### *4.5.1.3 Relations*

- **C5-F8: Reflexivity and social learning**. ► *Description:* To enable positive feedback loops, learning must be linked to all actions for change. This implies to develop skills for applying assessment methods (monitoring, evaluation), to create diverse formal and informal reflexivity formats that critically question progress towards the vision, and systematically manage new transformational knowledge created. To increase the depth of social learning, reflexivity thus needs to address all agency levels and relate to all core development processes (C5-F04 to C5-F07), as well as to leadership, governance and community empowerment (C5-F01 to C5-F03). ► *Gender-sensitive*: Yes. ► *Key reference:* Wolfram, 2016. ► *Further reading*: Annex V, page 21.

- **C5-F9: Working across human agency levels**. ► *Description:* Capacity development needs to occur at different agency levels simultaneously, addressing individuals, households, groups, organizations, networks as well as society at large. This should be increasingly reflected in all the above components (C5-F01 to C5-F08), including also the individual agency of

transformative leadership with a view to its social embeddedness. Working across agency levels accounts for the different (cognitive, psychological, social, ecological, economic, institutional, etc.) requirements and motives at each level, thus supporting their respective contribution to transformation. ► *Gender-sensitive*: Yes. ► *Key reference:* Wolfram, 2016. ► *Further reading*: Annex V, page 23.

- **C5-F10: Working across political-administrative levels and geographical scales**. ► *Description:* Given the cross-scale and multi-level nature of sustainability transitions (Coenen and Truffer, 2012), urban transformative capacity development should consciously incorporate this understanding into all the components discussed above (C5-F01 to C5-F09). While particular emphasis is put on the local scale and place (C5-F03, C5-F06), implications of interactions between scales (e.g., material flow) and administrative boundaries (e.g., regions, metropolitan areas, national policy) for decarbonisation and sustainability must be considered in terms of the questions raised and the stakeholders involved, thus increasingly enabling systemic reflection and responses. ► *Gender-sensitive*: Yes. ► *Key reference:* Wolfram, 2016. ► *Further reading*: Annex V, page 23.

### *4.5.2 Gender dimension in the socio-ecological & technical component*

#### *4.5.2.1 Participation of women in sustainability foresight*

Participation processes in a diverse area of assessments and foresight technologies/ methodologies tend to give a voice in future-thinking to both “the middle-aged male experts” as well as the “middle-aged male stakeholder” (Bauer and Pregernig, 2013). Communal leadership, formal and informal, local governance, community engagement, and community foresight (Eames and Egmose, 2011) are very well gender-sensitive and evenly sensitive to social status, age, ethnicity, and a variety of other dimensions of social life. (Sustainability) Foresight (Dixon, 2013), self-awareness and follow-up under-prediction of female leadership (Sturm et al., 2014) are as well sensitive to the applied underlying understanding of the biological assignment, social gender and connected traditional roles.

#### *4.5.2.2 Participation of women in the system transition process*

Politics itself is highly gendered in terms of access and participation, content, decision-making, and its consequences on society (Celis et al., 2013), which is even more evident in rural, distinct areas. Bearing in mind the gender gap in education and relating to the social status of the existing masculinity norm regarding authority and control in male-dominated coal-mining regions it is valid to anticipate lesser female participation in the systems transitions process. Parés et al.(2012) found that

> *‘Restricting participation to the least strategic aspects of decision making, coupled with the existing asymmetries between the community stakeholders and other kinds of stakeholders, such as political-technical ones, are two clear examples of the kind of factors that constrain this capacity [for participation to exert a substantive impact in a region transformation process]. Urban regeneration governance networks not only tend to be clearly asymmetrical but also tend to reproduce any kind of inequality of given power relationships. In other words, in these networks of governance, the community stakeholders tend to lose out.*

## 4.6 Dynamics and Patterns

### 4.6.1 Inventory of dynamics and patterns

Differently from the factors, which will be used to build the "research modules" of the five analytical components, dynamics and patterns will be used to interpret the cases as a whole (thus encompassing all the five components), in later stages of the project. This exercise includes case studies reports, comparative analysis between cases and scenario building. Thus, the dynamics and patterns are not associated with individual components but rather they form a more comprehensive **inventory** that can be used in such later stages. In particular, the inventory of dynamics and patterns will be useful to develop a "taxonomy of regional trajectories", as well as for developing the scenarios envisaged by the socio-economic model and by the socio-ecological and technical model. The inventory will therefore be also useful as a tool for a preliminary reflection on how these three different types of interpretation will communicate later on. The inventory is presented in the next paragraphs in which dynamics and patterns have been divided among those belonging to the socio-economic model (Para 4.6.2), those belonging to the socio-ecological and technical model (Para 4.6.3), and other territorial dynamics and patterns (Para 4.6.4). All the dynamics and patterns identified will constitute an input for the development of the taxonomy of regional trajectories. Finally, it is worth stressing that the inventory does not provide a list of organised and mutually exclusive dynamics and patterns – that will be the work to be done in the taxonomy. Consequently, several overlaps and redundancies can be found among the dynamics and patterns included in the inventory.

### 4.6.2 Dynamics and patterns for the socio-economic model

#### 4.6.2.1 Dynamics

- **D01: Change in the regional labour market**. Direct and indirect employment effects will trigger a change in the regional labour markets. In the short run, unemployment rates are very likely to increase in the regions. In the long run, young cohorts will respond to structural unemployment rates above the national averages by migrating to other regions. At the same time, the expansion of alternative energy carriers could trigger an increase in direct and indirect employment effects, at least in the short run. But this might counteract the negative direct and indirect employment effects. Therefore, the overall effect is ambitious. ► *Key reference*: Oei et al., 2020. ► *Further reading*: Annex IV, page 15.

- **D02: Change in regional economic activity**. Direct and indirect economic effects of energy transformation have consequences for the development of the regional economic activity. This change can be measured using different metrics. The most frequently used metric is GDP. The effect of a coal phase-out on regional GDP is highly likely negative in the short run, but it is ambiguous what the effect is in the long run. ► *Key reference*: Bohlmann et al., 2019. ► *Further reading*: Annex IV, page 16.

- **D03: Change in economic competitiveness**. The economic competitiveness of coal and carbon-intensive regions will change. For instance, coal regions already experienced a change in their economic competitiveness. The depletion of coal reserves, which are easy to access

and the expansion of alternative energy sources, will change the relative economic competitiveness of the regions. The ongoing transformation in the coal regions is also caused by the higher costs of extracting coal from less geographically favourable basins. ► *Key reference*: Galgóczi, 2019. ► *Further reading*: Annex IV, page 17.

- **D04: Change in energy price.** The supply of electricity from the coal regions currently determine electricity prices in their respective country. Marginal costs of electricity generated by burning lignite are the lowest among all energy sources used to produce electricity in Germany. Electricity generation by coal has implications for the electricity price paid by consumers. European electricity grids allow providing electricity to other regions. But local electricity prices are still different depending on the operator of the grid and the specific energy mix. ► *Key reference*: Oei et al., 2020. ► *Further reading*: Annex IV, page 18.

- **D05: Change in fuel poverty.** Fuel poverty depends on economic inequality. Economic inequality and changes in energy prices can either amplify or reduce fuel poverty. Lower-income groups spend a higher share of their income on energy consumption. Decarbonisation of the electricity sector can lead to a change in the price of energy. It can also change the share of income spent on energy consumption. This can further increase economic inequality. ► *Key reference*: Brauers and Oei, 2020. ► *Further reading*: Annex IV, page 18.

#### *4.6.2.2 Patterns*

- **P01: Lock-in situations**. The preservation of the status quo is a typical response to multiple factors and dynamics. This pattern is mainly a consequence of the denial to acknowledge the need for change. Even maintaining the status quo costs resources not available to adapt to the new situation. A potential consequence is lower economic competitiveness than usual. Lower economic competitiveness can lead to the decline of a region destroying communities and social networks. ► *Key reference*: Brauers and Oei, 2020. ► *Further reading*: Annex IV, page 19.

- **P02: Structural change**. Structural change is the reallocation of economic activity across different economic sectors (Herrendorf et al., 2014) and regions. It leads to a fundamental change in the composition of the economic structure. It is a consequence of multiple factors, such as technological progress, change in competition, and demography. The energy transition has the potential to change economic activity in the mining and quarrying sector. However, it is not clear what the net effects on the specific sectors are. ► *Key reference*: Oei et al., 2020. ► *Further reading*: Annex IV, page 20.

- **P03: Economic uncertainty**. Economic uncertainty describes the phenomenon of less predictable economic development due to structural change. This includes consumption, labour market, and investment decisions of households as well as investment decision of firms. But it also affects the planning process of governments. ► *Key reference*: Strambo et al., 2019. ► *Further reading*: Annex IV, page 21.

### 4.6.3 Dynamics and patterns for the Socio-ecological & technical model

#### 4.6.3.1 Patterns of the adaptive cycle in SES

- **P04. Resilience (perverse resilience)**. The capacity of a system to absorb disturbance and reorganise while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks (i.e., not tip into a different system state or basin of attraction) is defined as resilience. On the other hand, resilience is not always a good thing. Sometimes change is desirable, generally at larger scales, and then effective management requires overcoming the resilience in the system to precipitate changes at these scales *Key reference*: Walker et al., 2004. ► *Further reading*: Annex V, page 36.

- **P05. Transformation (purposive or emergent)**. Transformation is "the creation of a fundamentally new system when ecological, economic, or social (including political) conditions make the existing system untenable" (Walker et al., 2004). It implies a fundamental rewiring of the SES, its structure, functions, feedbacks, and properties, including in the way that power, authority, and resources are structured and flow through systems; the norms, values, and beliefs that underpin those structures and processes, and the rules and practices (laws, procedures, customs) through which they are embodied; the functions and dynamics of ecosystems; and the ways that all of these are connected to one another across multiple scales. Transformation may be the outcome of a purposive transition or an emergent change in the system. ► *Key reference*: Walker et al., 2004. ► *Further reading*: Annex V, page 38.

#### 4.6.3.2 Top-down Transition Paths in STS

- **P06. Radical reform (with regime adaptation)**. The regime is reformed according to the cultures and structures of some outside constellation, for instance, EU framework directives forcing local governments to reform their institutional structures. Many institutional transitions and public reforms are of this type. ► *Key reference*: Haan and Rotmans, 2011. ► *Further reading*: Annex V, page 39.

- **P07. Revolution (without regime adaptation)**. A constellation outside the regime invades the societal system and replaces the incumbent regime. Political and socioeconomic revolutions can be considered of this type. Also, governments providing new structures in sectors that were formerly self-regulating or locally arranged have characteristics of this type, centralising healthcare financing for example. ► *Key reference*: Haan and Rotmans, 2011. ► *Further reading*: Annex V, page 39.

- **P08. Collapse (failed transition)**. A re-constellation dominated path does not necessarily lead to a new stable societal system. Similarly, radical reform transitions like privatisations of entire sectors can lead to deterioration of the societal functioning of such a sector, like the privatisation of the railways in the UK. Similarly, large-scale collectivisations have been known to lead to badly functioning systems, like the collectivisation of Cuban agriculture. ► *Key reference*: Haan and Rotmans, 2011. ► *Further reading*: Annex V, page 39.

#### *4.6.3.3 Bottom-up Transition Paths in STS*

- **P09. Reconfiguration (with regime adaptation)**. One or several niches are empowered and become a niche-regime which in turn takes on the role of the dominant constellation thus becoming the new societal regime. ► *Key reference*: Haan and Rotmans, 2011. ► *Further reading*: Annex V, page 39.

- **P10. Substitution (without regime adaptation)**. Like reconfiguration with the difference that the regime is not involved in the empowerment process. The niche or niches scale-up on their own force or merits and the subsequently emerging niche-regime successfully competes with the regime and takes its place. Technological substitutions are of this type, but one can also think of new popular political parties invading the political landscape. ► *Key reference*: Haan and Rotmans, 2011. ► *Further reading*: Annex V, page 39.

- **P11. Backlash (failed transition)**. Niches initially gain in power or popularity, while their novel way to meet societal needs still fails to become the new mainstream. This can happen if the demand for certain functioning grows too rapidly and the niche is unable to consolidate this and consequently cannot cope with for instance swings in demand. Another possible path to a backlash can be that some novel functioning is initially adopted by many until some unforeseen risk or problem becomes apparent and the niche is abandoned. ► *Key reference*: Haan and Rotmans, 2011. ► *Further reading*: Annex V, page 39.

#### *4.6.3.4 Squeezed Transition Paths in STS*

- **P12. Teleological (with regime adaptation)**. A regime adapts to changed circumstances not by reforming itself but by allowing outside influences to re-constellate structures and cultures and simultaneously incorporating novel functioning in these processes. If the regime is actively adapting and steering in transition processes, connecting niches with landscape developments one can almost speak of a managed transition. This led to an idea of “transition management”, a governance framework to propagate this type of transition. ► *Key reference*: Haan and Rotmans, 2011. ► *Further reading*: Annex V, page 39.

- **P13. Emergent (without regime adaptation)**. Niche functioning and influences from outside the societal system somehow team up to a transition without the active influence of the incumbent regime. For instance, in the communication revolution of the past decades, niche functioning like mobile telephony and internet use, empowered by technological developments and re-constellated through liberalisation of communication markets, led to a transition from the then reigning communication regime, roughly speaking characterised by phone, fax, and postal services. ► *Key reference*: Haan and Rotmans, 2011. ► *Further reading*: Annex V, page 39.

- **P14. Lock-in (failed transition)**. This can be the case if, stimulated by government schemes or international pressure, the regime incorporates and stimulates a different way to fulfil a societal need, say a new energy production technology or liberalisation of internal markets and this novel way is not sufficiently developed or too incompatible with current structures or demands. This would then lead to the situation of an alternative functioning in the margin of the mainstream or in a troublesome manner. ► *Key reference*: Haan and Rotmans, 2011. ► *Further reading*: Annex V, page 39.

#### 4.6.3.5 Transformation Paths in STS

- **P15. Transformation**. The regime essentially transforms on its own, successfully adapting to the point that societal needs are again met adequately and no tensions or stress plague it. Adaptation can have taken the form of absorbing niche functioning or co-evolution with it. ► *Key reference*: Haan and Rotmans, 2011. ► *Further reading*: Annex V, page 39.

- **P16. System breakdown (failed transition)**. Attempts of the regime to adapt do not lead to a new societal equilibrium and the regime cannot meet the societal needs adequately anymore. Various forms of societal collapse can be classified under this type. ► *Key reference*: Haan and Rotmans, 2011. ► *Further reading*: Annex V, page 39.

### 4.6.4 Territorial dynamics & patterns

- **D06. Ageing population**. Rural and remote areas in many countries experience more pronounced population ageing than urban areas and subsequently, have a higher share of older residents. This dynamics of an ageing population is certainly related to youth outmigration for work, or study, and with the consequent decrease of fertility rate (C4-01), or return migration of the elderly. Lower population density and more geographically dispersed populations make it more difficult and expensive to create and maintain a comprehensive service infrastructure as common in urban areas. Consequently, rural populations have less access to services and activities and their situation may aggravate further when combined with poorer socio-economic conditions. ► *Key reference*: Scharf et al., 2016.

- **D07. Environmental degradation**. Environmental degradation is a process through which the natural environment is compromised in some way, reducing biological diversity and the general health of the environment. Mining and other carbon-intensive industrial activities are associated with considerable environmental degradation. This encompasses abandoned surface mines, underground galleries, lowered groundwater levels, and contaminated sites in mining and related industries. ► *Key reference*: Wirth, et al., 2012. ► *Further reading*: Annex II, page 28.

- **P17. Depopulation**. 'Depopulation' refers to a process in which the population density of an area decreases steadily over time. Depopulation can be caused either by short-term shocks (pandemics, wars, famines, or catastrophes) or by long-term stress trends at the territorial level. Depopulation not only is a direct result of persistent out-migration but also reflects large second-order effects expressed in declining fertility and rising mortality - usually associated with population ageing ► *Key reference*: Johnson and Lichter, 2019. ► *Further reading*: Annex II, page 24.

- **P18. Circle of decline**. Structurally weak regions (sparsely populated, rural or mountain areas, peripheral regions, etc.) are locked into a self-reinforcing circle of decline': outmigration is generally accompanied by a decrease in investment in the region which further erodes the attractiveness of a region and the rotation of a downward spiral of demographic decline through falling fertility rates and enforced ageing of the remaining population. This also implies a lower attractivity of the region and thus an increase in youth outmigration. The circle of decline can be described also as triggered by two mutually reinforcing trends: firstly, a shortage of jobs and sustainable business activity; and secondly, inadequate and declining services. ► *Key reference*: Hess, 2018; Gruber and Scorn, 2019.

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# ANNEX 1

## Socio-cultural Component

Short Report on Key Factors, Dynamics and Patterns

# Document Control Sheet

| **Project Title** | |
|---|---|
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| **Task** | **1.5** |
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## Table of Contents

# 1. The Socio-Cultural Component

## 1.1. Introduction

### *1.1.1. Institutional framework*

This short report summarises the conceptual specification of the socio-cultural component of the Multidimensional Analytic Framework (MAF) of the ENTRANCES project. The itinerary of the component's conceptual specification has been carried out within the Task 1.4. Moreover, the work has been carried out in constant dialogue with the conceptual specification of the other components (Tasks 1.1, 1.2, 1.3, 1.5, and 1.6) through the participation in a cross-cutting workspace (Task 1.7). The short report has been drafted by K&I and it has incorporated the contribution coming from the other partners through written or non-written interaction and exchanges from May 2020 to December 2020.

### *1.1.2. Starting points*

The work of conceptual specification has been based and informed by some preliminary information contained in the project proposal (DoA) and further specified in the "Factors Description Grid" (D1.1). In this regard, two starting points can be highlighted.

A **first starting point** was the description of the component contained in such documents, that can be summarised in the following "intrinsic" features.

- It was already established that the component's focus should be on socio-cultural stress, i.e. a reaction to social change when adaptation is not adequate.
- In this perspective, the analysis was expected to be centred on the identification of the different stress factors (stressors) affecting coal and carbon-intensive regions at the territorial level. In this context, de-carbonisation was to be considered only one of the stressors to be included in the analysis. Other examples offered were about large scale transformation ongoing in society, such as automation, digitisation, migrations, etc.
- The component was expected to leverage on studies related to different types of territories affected by de-territorialisation dynamics, such as border regions, mountain areas, small islands, outward regions, former industrial areas and towns, internal regions, etc.

Furthermore, a set of consideration can be expressed about the role of the socio-cultural component in the MAF as it was portrayed in the "Ex-ante conceptual map" contained in D1.1. The following "relational" features represent the **second starting point** of the component specification.

- The socio-cultural component was devised to be the only one **addressing explicitly the territorial dimension**. The component looks at how different types of changes are creating stress in the "structure" of territorial organisation. In fact, in the perspective generated by this component, "territory" is to be considered as a social institution rather than a neutral bounded space or a container (Elden, 2010).

- The component role was that of broadening the spectrum of enquiry of the MAF **beyond the de-carbonisation process**, thus balancing the focus on de-carbonisation of the other components. In practice, this meant to extend the analysis to those factors that are not distinctive of coal and carbon-intensive regions but are constitutive of the process of territorial change of these regions

In synthesis, through describing the tensions and stress in action in the territorial dimension, this component wants to avoid "to reduce" the territorial challenges faced by coal and carbon-intensive regions to a mere product of the decarbonisation process, but rather see whether, how, and to what extent in the territories under examination, other ongoing transformations (e.g., digitalisation, migrations, etc.) are determining a situation of socio-cultural stress at the territorial level.

Based on these starting points a set of key features of the components have been specified.

## 1.2. Component key features

The work of conceptual specification consisted of specifying those aspects that "ex-ante" were expected to be constitutive of the process under investigation, i.e. the socio-cultural stress. This specification was conducted by implementing three intertwined actions:

- A specification of the theoretical approach (based on theory)
- A scoping review of the empirical literature (related to previous empirical results)
- A selection through dialogue (related to the framework).

The key features of the component can be described following these three specification actions envisaged by the project.

### *1.2.1. The theoretical basis*

#### *1.2.1.1 Historical background*

The component is based on the theory of stress-strain element of the social structure. This theory has been developed by Bertrand (1963), furtherly developed by Merton (1969), and then applied to different areas of research included regional sociology[1]. In the sixties, such theory was developed for creating a bridge between the structural-functional theory and conflict theory, and for better handling empirical data related to conflict and change. These features make it compatible with other recent theories developed for similar scopes, such as the theory of the strategic action fields (Fligstein & McAdam, 2012).

#### *1.2.1.2 Stress as an element of the social structure*

Differently from other theories which interpret socio-cultural stress as the stress at the individual level produced by socio-cultural factors, the stress-strand theory is focused on the stress at the level of the social organisation (social structure). Therefore this theory can be applied to different societal, organisational or

[1] Interestingly enough, Bertrand is considered "the father" of Regional Sociology; see Bryant & Ballweg (1992).

institutional contexts or fields (see Bourdieu & Wacquant, 1992) which are characterised by "being structured".[2]

The basic idea is that the social structure – i.e., the interconnected set of rules, habits, symbols, role models, routines that regulate and characterise a certain form of social organisation (or social field) – has contradictory needs: on one side it should be rigid enough to ensure stability to the field, but on the other side, it should also be flexible enough to allow for adjustments since not all the actors operating in the field share to the same extent the values, norms, rules that characterise the social organisation.

When conflictual or contradictory needs, ideas or processes arise within a certain organisation or field there are also processes of disorganisation which place stress on the social structure and necessitate some sort of adjustment (e.g. adjustment in terms of norms, rules, models, symbols, etc. or their configuration) of the social structure. For this reason, stress can be considered also as a pressure to change. At the same time, the theory explains the stability (or resiliency) of the social structure as it can tolerate a certain amount of stress.

The theory is based on the articulation of the "stress-strain" pair: stress is an element inherent to the social structure in a given institutional or organisational field, that cannot be observed per se but manifest itself in "strains" of different types such as conflicts, tensions, ambivalences, etc. Therefore the "strains" can be interpreted also as the manifestation of the stress in action at the structural level.

#### *1.2.1.3 Stress accumulation*

A stress factor (or stressor) can be defined as a social process that has the potential to activate stress within the social structure. Stress factors vary over a wide range of characteristics: for their origins, that can be either from within or from outside; for intensity, as some pressure to change can be stronger than others; or for the duration, as some stress-strain can be temporary or contingent while other can be longlasting in society. Moreover, stress and strains are more visible in certain periods or a certain type of contexts. Finally, the activation of stress depends also on the coping strategy adopted to deal with the stress factor. An adequate coping strategy may reduce or even prevent the activation of stress-strains, while, in other cases, a certain coping strategy may trigger stress (secondary stressor).

It is worth to be noticed that, following this theory, all the forms of social aggregation are characterised by some degree of disorganisation which produces constant adjustments, and therefore stress-strain can be considered a “physiological” condition of any social organisation or field. At the same time, the accumulation of different stressors (with high intensity and duration) may lead to outcomes different from adjustments, such as field ruptures or radical change. The accumulation of different stress factors, thus, indicates a context in which the probability that such extreme outcomes are higher than in a context where only a few sources of stress are impacting the field. In other terms, when the stress factors accumulate the emergence of new actors, processes or relation is more probable[3].

#### *1.2.1.4 Socio-cultural stress at the territorial level*

Summarising what has been exposed so far, the stress-strain theory can be used to study different types of institutional and organisational fields to explain their change and stability dynamics.

[2] The original framework of Bertrand (1963) referred to “social system” but with a conceptualisation of the system as being “structured” rather than one based on equilibrium or balance. For this reason, we refer here to stress-strain as an element of the structure of a given social field.

[3] In any case it has to be considered that even a single stress factor, when characterised by a very high intensity (e.g. imposing from outside of certain cultural or development model), can favour the emergence of radical change or field ruptures.

In the project, the theory will be used to investigate the stress-strain affecting the *territorial milieu*, i.e. the structured set of actors and relations existing over a certain geographical area (Camagni, 1991). In this perspective, the socio-cultural component will focus on those stress-strains that may trigger de-territorialisation – the weakening of ties between a community and its territory – as well as re-territorialisation dynamics. In this regard, it is worth to be highlighted that for Deleuze e Guattari (1988) de-territorialisation is always linked with related processes of re-territorialisation, which does not mean returning to the territory as it was before, but rather how the elements that have been deterritorialised recombine and generate new relations[4].

The territorial milieu will be considered as a socio-cultural field encompassing different dimensions of human life: the institutional dimension (authorities, roles, rules, etc.), the operational dimension (standard, routines, behavioural models), the interpretative dimension (ideologies, shared interpretative schemes, etc.) and the symbolic dimension (symbols, rites, myths, etc.).

From now on, following such interpretation adopted in the project, we will refer to this theory as Socio-Cultural Stress (SCS).

#### *1.2.1.5 Global cultural flow activating stress at the territorial level*

Following the starting points of the component, the analysis of the Socio-Cultural Stress will not be focused directly on the distinctive features of the coal and carbon-intensive regions, but rather it will look at how the processes connected with globalisation are producing stress at the level of the territorial organisation.

This focus has been selected for different reasons. *Firstly*, it allows to include in the overall picture of the Multidimensional Analytic Framework, those processes that albeit being *constitutive* of the ongoing territorial transformation are not necessarily *distinctive* of the transition of coal and carbon-intensive regions, as such processes are affecting a broader range of territories. *Secondly*, the focus on the socio-cultural impacts of globalisation allows focusing on those aspects that have not been addressed by the other components. As all the other components focus on the decarbonisation process, they can miss those territorial transformation linked to globalisation that is not strictly related to the energy transition. *Thirdly*, the focus on stress factors related to globalisation allows identifying processes and phenomena which are expected to have a longlasting effect on the territorial organisation, rather than on other stress factors that may be more ephemeral. This will be particularly important for producing insights useful for the elaboration of the transition policies which in most of the project cases should have medium and long term perspective.

To conduct its analysis the component will adopt as a theoretical reference the theory of the five "scapes" developed by Appadurai (1990, 1995, 1996). In this theory, Appadurai identifies five dimensions of global cultural flows (the five "scapes"): Ethnoscape, related to flows of people; Technoscape, related to flows of technologies; Financescape, related to financial flows; Mediascape, related to flows of images and other cultural media; Ideoscape, related to flows of ideologies (structured worldviews adopted by organised groups). Moreover, in the last decade, the notion of Naturescape i.e. flows of non-human elements, was added by other authors (Sankaran & Nkengasong, 2018). The different flows, which are characterised by disjuncture[5], are interpreted by Appadurai as vectors of deterritorialisation, as they can lead to a weakening of the tie between a community and its inhabited space.

[4] In our case the relationship between stress and disorganisation/reorganisation dynamics highlighted by the original theory of Bertrand (1963) will be interpreted in terms of de/re-territorialisation.
[5] While in the past the cultural flows were coordinated among each other, Appadurai highlight the out-of-joint nature of many of the relations among different global flows today.

The theory including six scapes has been adopted as a reference taxonomy for the identification and organisation of the stress factors included in the component (see next Para.).

### *1.2.2. The relation with previous empirical results*

#### *1.2.2.1 Capitalising the existing empirical knowledge*

For identifying the main factors that "ex-ante" may plausibly be affecting socio-cultural stress in coal and carbon-intensive regions, the work of conceptual specification has focused on those phenomena already identified as relevant and significant in previous empirical studies. A scoping review of the literature was conducted for identifying such factors.

Since in the literature there are few (if any) studies looking at the socio-cultural stress in the broad perspective described in the previous Para, the scoping review was developed based on a semantic domain obtained by combining a set of keywords directly related to the stress factors *types (stressors keywords)* with a set of keywords related to different types of territory *(territories keywords).*

The role of the **stressors keywords** was focusing specifically on processes of phenomena connected with the "six scapes"., i.e. the dimensions of global cultural flows. In this regard, for each of the 6 dimensions, a set of keywords related to specific processes have been identified. For example, the Ethnoscapes, have been divided into the following keywords: "out-migration", "in-migration", "return migration", "seasonal migration" and "tourism". The scoping review of the literature thus focused on the studies dealing with these different phenomena and processes.

The role of the **territory-type keywords** was that of focusing only on those territories that may be considered affected, at least to some extent, to de-territorialisation processes similar to those that are affecting coal and carbon-intensive regions. While global processes are undoubtedly challenging the way in which all the territories are organised and structured, the scoping review of the literature selected only the studies referred to areas that similarly to coal and carbon-intensive regions are affected by large phenomena of de-territorialisation, as they are either weakening their local identity or experiencing a progressive loss of importance of their historical function. For this reason, the review looked for studies focused on the "de" – regions, i.e., de-industrialised, declining, de-populated, and, obviously, de-carbonised regions. Moreover, a set of other territorial keywords have been considered: internal regions, outward regions, peripheral regions, former industrial areas, sparsely populated regions, lagging behind regions, and shrinking regions.

The semantic domain of the literature review was obtained by crossing the territory-type keywords with the thematic keywords. For example, the thematic keyword "outmigration" (related to the flow of people – Ethnoscapes, see next Para.) has been crossed with all the other territory-type keyword, looking for the socio-cultural impacts of outmigration in internal areas, former industrial regions, etc.

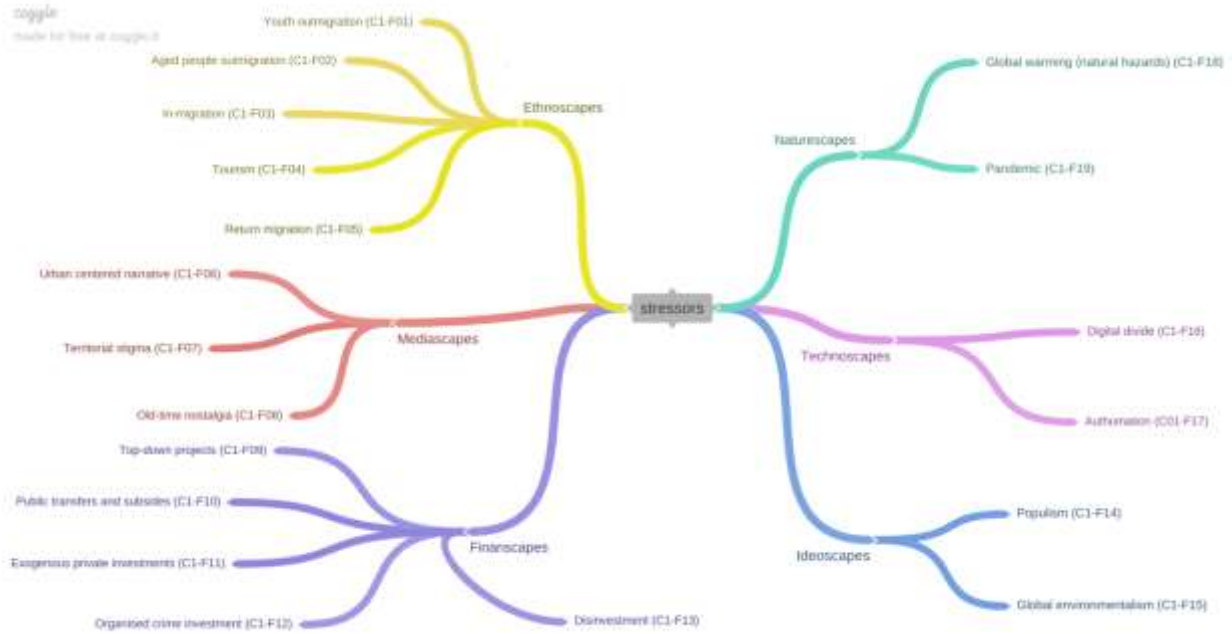
Besides the identification of the semantic domain, the scoping review of the literature selected only those papers containing evidence of the stress-strains generated at the territorial level by the global processes analysed. The analysis of the selected literature, allowed to single out a set of factors that "ex-ante" can be considered as constitutive of the socio-cultural stress as they reflect already available results in term of theoretical and empirical knowledge. The list of factors has been further refined through the dialogue conducted in the cross-cutting workspace (see Para. 1.2.3.)

The outcome of the literature review is the socio-cultural stress tree, which is presented in the Para 1.2.2.2 (below), while the different texts analysed are described in short in Para 3.

### *1.2.2.2 The socio-cultural stress tree (SCS tree)*

As stated above, the socio-cultural stress factors have been organised across the six dimensions/scapes and they are summarised in the picture presented below, that has been called during the project colloquium the Socio-Cultural Stress Tree.

**Figure 1**: *The socio-cultural stress tree*




Each branch of the tree capitalises the “empirical knowledge” contained in previous studies about stressors that plausibly can be in action in the cases considered by the project. The picture includes a set of heterogeneous phenomena, e.g., some of them are cognitive (old-time nostalgia) and some others are operational (youth outmigration). Notwithstanding that, their common rationale is that (a) all of them are connected with “flows of something”; (b) all these factors can potentially produce socio-cultural stress on the territorial milieu, as all of them generates conflicts and/or tensions that put under pressure the territorial structure. In this sense, globalisation, in its different dimensions and expression, can be considered as a process that is putting under stress the territorial patterns of organisation, especially in those areas that have been "territorialised" based on functions or sectors that are loosening their key historical role in the current globalised environment.

While the socio-cultural stress tree is an original synthesis of the different factors that potentially can generate tensions and stress at the territorial level, a set of cautions should be formulated to better understand what is represented in the tree. A *first caution* in reading the SCS tree is that the component will not study each of the factors in its intrinsic complexity, but rather, it will look at whether, how, and to what extent each of the considered factors is producing stress and strains at the territorial level. A *second caution* is that albeit the tree provides a broad overview of the factors that plausibly are causing stress at the territorial level, it does not aim to provide an exhaustive list of all the possible socio-cultural stressors.

### *1.2.3. Framework relation*

The socio-cultural component, with its list of factors is part of a broader framework composed by other 4 components: C2 socio-psychological component, C3 socio-political component, C4 socio-economic component, C5 socio-ecological and technological component.

#### *1.2.3.1 Interaction with the other components*

The component has been devised to match with the other four components, and thus to avoid overlapping and ensuring complementarity. For this reason, as explained in the final conceptual map, the socio-cultural component is focused on the stress provoked by phenomena that in many cases are addressed by the other components, and especially by the socio-psychological (C2), socio-political (C3) and socio-economic (C4). For example, when talking about out-migration, the socio-cultural component will look at how this phenomenon is creating stress (conflict, tensions) at the level of territorial organisation, rather than looking at what are the drivers of migration at the individual level (socio-psychological component) or the quantitative/demographic aspects of migration (socio-economic component).

#### *1.2.3.2 Forms of stress present in other components*

The choice of focusing only on the stress generated by global cultural flows is also related to the fact that, in the multidimensional analytic framework as a whole, other forms of endogenous stress affecting the territory are already considered, even though they are not always labelled as "stress". In particular, the stress related to change in the labour market (e.g. unemployment) and their effect on the territory are already considered in the socio-economic component (C4); stress related to lack of governance or weak leadership is already considered in the socio-ecological and technical component (C5); the stress related to conflicting interpretations of the energy transition is addressed by the socio-political component (C3); the stress at the individual level is considered in the socio-psychological component (C2). As expressed before (Para 1.1.2. and Para 1.2.1.5) the component was specified with the intent of complementing the other components and avoiding overlaps.

#### *1.2.3.3 Stress and coping strategies*

As it is possible to see, the socio-cultural component is focusing mainly on stress factors, and it addresses the coping strategies only when they can trigger further stress (secondary stressors). The analysis will therefore touch the coping strategies only in a tangential way. While a broader focus on coping strategies is theoretically part of the analysis of socio-cultural stress, a minor space has been given to this aspect, since another component, and namely, the socio-ecological & technical component (C5), will focus its analysis on transformative capacities, and thus broadly encompassing the issue of coping strategies adopted at the territorial level.

#### *1.2.3.4 Dynamics and patterns*

The component has not included in its final list the three dynamics and patterns identified during the scoping review of the literature (i.e., "ageing population", "decarbonisation" and "decline") since similar territorial dynamics and patterns have been identified also by other components. During the cross-component discussion, it has been how this type of dynamics and patterns can be more usefully adopted for the interpretation of each case study "as a whole" and for comparing them rather than for the specific analysis of each component.

### 1.3. Component synthetic description

Based on the key features presented above, a synthetic description of the component is provided below.

- **Component Lead partner**: Knowledge & Innovation (K&I).
- **Overall approach**: Socio-cultural stress.
- **Domain of enquiry**: The component investigates the socio-cultural stress factors affecting the territorial system. It is worth highlighting that the domain of enquiry of this component is related to stress within the social structure rather than at the individual level. The component will not focus only on decarbonisation but will analyse the different factors of stress (stressors) that are in action in coal and carbon-intensive regions. Particular attention will be paid to a set of processes connected with globalisation, i.e. the global flows of people, images, technologies, natural elements, ideologies, and money (Ethnoscapes, Mediascapes, Financescapes, Ideoscapes, Technoscapes, Naturescapes), that lead to de-territorialisation. The component will focus on the relevance and the significance of different stress factors in each region, thus allowing to identify a specific profile of socio-cultural stress for each case.
- **Theory**: The following theoretical building blocks constitute the skeleton of the component:
  - Stress: tensions, conflicts and ambiguity within the social structure (cannot be observed directly)
  - Strain: conflicts, tensions, resistances, etc. in individual and collective behaviours (can be observed directly)
  - Stressor (or stress factor): broad social phenomena and social processes that potentially may trigger stress-strain in the territorial organisation, that may vary for origin (internal or external) intensity or duration
  - Secondary stressors: in some cases, some coping strategy may trigger some further stress.
- **Primary method**: Focus group.
- **Secondary methods**: Desk research, In-depth interviews.
- **Case diversification**: A similar scheme will be applied to all the cases.
- **Research area definition**: Coal and carbon territory, The territory in which the "coal and carbon" features are considered as a distinctive part of the local identity or are considered as a key asset for the local community.
- **Unit of observation**: The territory itself.

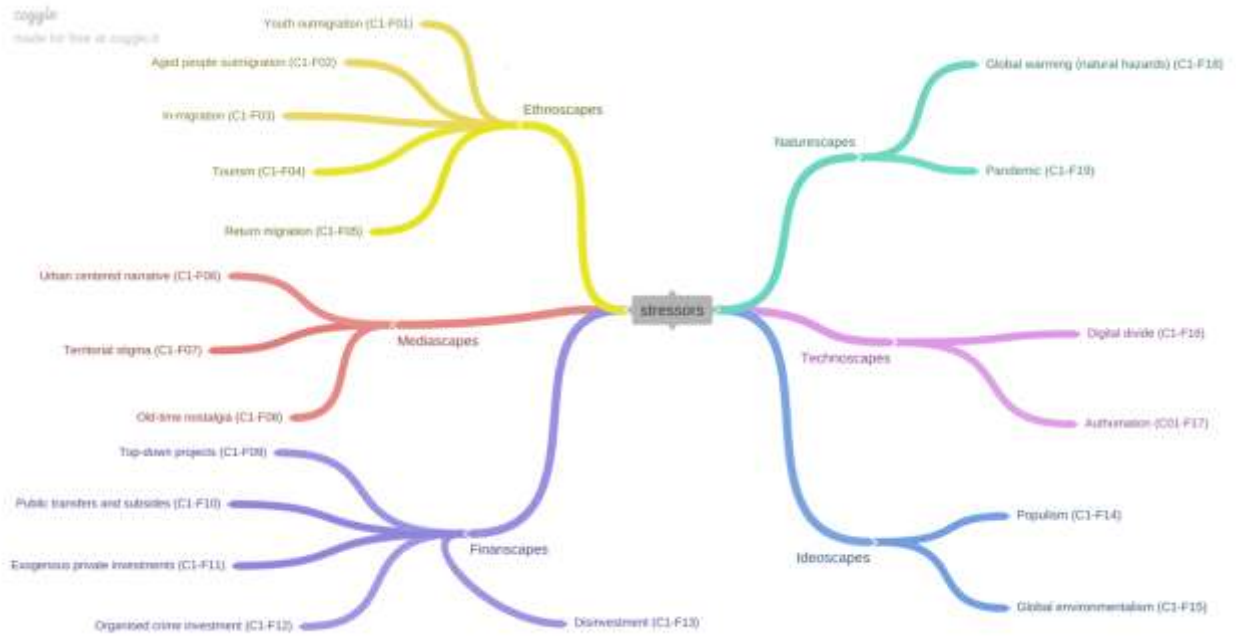
## 2. Factors, Dynamics and Patterns

### 2.1. Overview

The socio-cultural component will analyse 19 factors. The factors are divided as follows: 5 stress factors are related to the stress caused by Ethnoscapes (flows of people); 3 stress factors are related to Mediascapes (flows of images); 5 stress factors are related to Financescapes (financial flows); 2 stress factors are related to Ideoscapes (flows of ideologies); 2 stress factors are related to Technoscapes (flows of technologies), and

2 stress factors are related to Naturescapes. All the factors are described with the standardised grid used for the scoping review of the literature. For each factor, a specific item is dedicated to gender mainstreaming.

**Figure 1**: *The socio-cultural stress tree*




## 2.2. Factors

### *2.2.1. Youth outmigration*

- **Code**: C01-F01

- **Description**: Young people's location choices are shaped by complex drivers. These involve more than just economic factors. Young peoples' decisions about where to settle and live are not only influenced by finding a job, but also by access to higher education, having a variety of career opportunities, a work-life balance, affordable housing, high quality of life, as well as a broad social and cultural infrastructure. All of these factors are strongly related to aspects of lifestyle that shape young people's desires and aspirations and that often lead to young people leaving their often rural homes and moving to urban areas. Hence, migration is also an escape from the societal constraints of the local place, as it represents an opportunity for finding freedom elsewhere. Such mobility causes negative consequences at the regional level, especially in regions that are experiencing a decline. Youth emigration is not only connected to the losses in productivity, human capital and innovation (brain drain); it also means that potential parents are leaving and therefore lead to a decline in population. This phenomenon can be considered a factor of socio-cultural stress, as it contributes to creating a tension with the implicit or explicit roles/rules/or value of the territorial milieu, in this case, the regeneration of the bond with territory across generations.

- **Examples/Indicators**:
  - Conflicting feelings of attachment, detachment, pride and entrapment of young people (Petersen & Gram**,** 2017)
  - Social erosion and to the perforation of social networks (Leibert and Wiest, 2016)

- Tensions between younger and older generations (Gruber & Scorn, 2019)
- Intensification of the process of demographic ageing, which leads to shrinking labour forces and increasing demands for geriatric care (Gruber & Scorn, 2019)
- Lack of inheritance of local lands, properties and businesses (Makkai et al., 2017)

- **Type of region**: All

- **Regions**: All

- **Gender-sensitive**: Yes. In some countries (North and Central Europe) it has been observed a greater proportion of women to leave peripheral areas, not only in search of employment but also better educational and social opportunities (outmigration is selective for gender and age) (Pedersen & Gram, 2017). Moreover, young women tend to leave home earlier than young men, in rural and urban places alike (Jones, 2004), and they are more likely to migrate away from rural communities for education (McLaughlin et al., 2014) and "more female-friendly labour markets" (Leibert, 2016)

- **Method(s)**: Focus group, Desk research

- **Internal relations (explained)**: Urban-centred narrative (C1-F06)

- **Possible connection**: Socio-Psychological, Socio-Economic

- **Sources**: Petersen & Gram (2017), Makkai et al. (2017), Gruber & Scorn (2019), Jones (2004), McLaughlin et al. (2014), Leibert (2016)

- **Other comments**: This factor can be integrated through collecting data on youth outmigration. Such data can take into account the gender of the migrant population.

### *2.2.2. Aged outmigration*

- **Code**: C1-F02

- **Description**: With ageing and improved health and health care, mobility of the elderly and middle-aged people is on the rise. This type of migration can include many different trajectories, such as return retirement migration, as well as mobility of certain specialist workers, or parents leaving after their children. Older individuals move for economic as well as non-economic reasons. Such reason includes retirement, but also relationship change, whether forming a new partnership or experiencing a relationship breakdown. Some studies (Pennington, 2013) highlights how there is a continuum between movement in later life and at younger ages. Aged migration represents a loss in the social texture and the historical and cultural memory of places.

- **Examples/Indicators**:
- Reduced proximity, interaction, practical help and care, affirmation and emotional support, for descendants, other relatives and community members (Warnes & Williams, 2006)
- Loss in the social texture and the historical and cultural memory of places (Zaiceva, 2014)
- Loss of source of income for the region of origin (Pannington, 2013)

- **Type of region**: All

- **Regions**: All
- **Gender-sensitive**: Based on data from the UK - mine closure leads to a relative decrease in male-female population in the area - a significant change in gender composition: there is a drop in the share of women in the total population. Mine closure leads to an increase in the share of single, unmarried, individuals (Aragon et al. 2018)
- **Method(s)**: Focus group, Desk research
- **Internal relations (explained)**: Youth outmigration (C1-F01)
- **Possible connection**: Socio-Psychological
- **Sources**: Zaiceva (2014), UNECE (2016), Warnes & Williams (2006), Pennington (2013)
- **Other comments**: This factor can be integrated through collecting data on aged outmigration. Such data can take into account the gender of the migrant population.

### *2.2.3. International immigration*

- **Code**: C1-F03
- **Description**: Decreasing of birth-rate and outward migration are among the main factors of population decline in some regions. Such a decline can at least partially be compensated (or mitigated) by an increase of international immigrants in particular in shrinking rural areas, former industrial towns, and other peripheral regions. In some cases, this phenomenon has been documented also in coal and carbon-intensive regions. In the very last years, this process has been fostered by the high number of refugees and asylum seekers in some European countries (e.g. Germany). The fast increase of immigrants in the regional population is certainly a socio-cultural stress factor, as it implies a fast change in the cultural landscape of the area, and is accompanied with tensions and even overt conflicts at the local level.
- **Examples/Indicators**:
  - Lack of integration due to a short period of staying or decision of immigrants to move to large cities after a period of staying in rural/peripheral areas (Gauci J. P. 2020)
  - Parallel lives and isolation among both minority ethnic groups and settled communities (Threadgold et al. 2008)
  - Feeling of insecurity: when immigrants living parallel lives and not mixing with ‘host’ communities, immigrants communities are perceived as ‘dangerous’ communities (Threadgold et al. 2008)
  - Host communities feeling uncomfortable because immigrants communities are perceived as different (for ethnics and cultural aspects, including dressing habits, language, etc.) since they are not assimilated with the host culture (Threadgold et al. 2008)
  - Presence of prejudice and lack of direct contacts of host communities with immigrants (Gauci J. P. 2020)
  - Hostility towards asylum seekers as they are considered to drain resources without contributing (Gauci J. P. 2020)
  - While middle-class (particularly but not only white) migration is largely invisible, migration (particularly involving visible or language difference) into deprived working-class communities is not (Threadgold et al. 2008)

- Presence of tensions due to the established working-class groups responding negatively to the newcomers (Threadgold et al. 2008)
- The movement of immigrant populations and their descendants into the run-down spaces vacated by indigenous residents inevitably increased the conspicuous stigma attached to inner areas (Powell 2018)

- **Type of region**: All those affected by international immigration
- **Regions**: To be determined during the state of the art analysis
- **Gender-sensitive**: The intensity of stress seems to be higher for different ethnicities (non-white) and for women (e.g. use of the veil, immigrant women also has a greater propensity to isolation as they have home duties and in some cases either they do not work, and don't know the host language) (Threadgold, 2008)
- **Method(s)**: Focus Group, Desk Research
- **Internal relations** (explained):
- **Possible connection**: Socio-psychological component
- **Sources**: Galera et al. (2018), Threadgold et al. (2008), Gauci (2020), Power (2018)
- **Other comments**: The plausible presence of this factor can be assessed case by case during the state of the art analysis

### *2.2.4. Return migration*

- **Code**: C1-F04
- **Description**: The process of mass emigration is generally accompanied in time by return migration. Thus, those countries which have experienced an intense outmigration of nationals are generally exposed to a return to the homeland of those who left home. Similarly to the process of mass emigration, mass returns, especially when occurring in a short period, could create a serious challenge for society and in the labour market. In this context, while return migration is generally considered an opportunity to cope with regional depopulation and for dealing with a regional decline, recent studies (Anacka & Wójcicka, 2019; Hausmann & Nedelkoska, 2018; Evtimova-Ivanova, 2012) conducted in some European countries (e.g. Poland, Bulgaria, Albania, Greece) on the regional impact of return migration show that it can also generate strains at the territorial level both in the labour market and at the cultural and social level. Some of these strains are listed below.
- **Examples/Indicators**:

- A higher degree of unemployment of return migrant (Evtimova-Ivanova, 2012)
- Skill waste of return migrants (Duda-Mikulin, 2018)
- Lack of capacity to integrate higher skills of the return migrants in the labour market (Anacka & Wójcicka, 2019)
- Tensions related to increased competition with residents on jobs (Hausmann & Nedelkoska, 2018; Lesińska, 2013)

- Instability of returnee migrant re-settling in the home region (as migrations are fluids or circular, especially in a situation in which there are no administrative barriers as it is in the European Schengen area). (Anacka & Wójcicka, 2019; White, 2014)

- **Type of region**: Regions with a significant presence of return migration

- **Regions**: To be determined during the state of the art analysis (guess on the regions from Poland, Slovakia, Romania, Germany)

- **Gender-sensitive**: Different migration patterns and related challenges are registered in the literature for man and women. For example, recent studies (e.g. Duda-Mikulin, 2018) shows that a Polish migrant man is more likely to return than Polish migrant women (migrant women are more likely to migrate together with their husband).

- **Method(s)**: Focus group, Desk research

- **Internal relations** (explained):

- **Possible connection**:

- **Sources**: Lesińska (2013), Karolak (2020), Anacka & Wójcicka (2019), White (2014), Duda-Mikulin (2018), Kleinepier et al. (2015), Hausmann & Nedelkoska (2018)

- **Other comments**: The plausible presence of this factor can be assessed case by case during the state of the art analysis

### *2.2.5. Tourism*

- **Code**: C1-F05

- **Description**: Tourism is identified as an important sector for the economic development of rural areas and shrinking regions. Notwithstanding that, in the literature, a broad array of phenomena are associated with tourism as a socio-cultural stress factor at the territorial level.

- **Examples/Indicators**:
  - Local price inflation (Egbali & Bakhsh, 2011)
  - Migration of work power (Egbali & Bakhsh, 2011)
  - Seasonal patterns of demands (Egbali & Bakhsh, 2011; Nair et al., 2015)
  - Change of local cultural patterns for conforming to tourist culture (Egbali & Bakhsh, 2011; Nair et al., 2015)
  - Different types of pollutions and residues made by tourists (Egbali & Bakhsh, 2011; Nair et al., 2015)
  - Destroying available animal shelters by constructing new buildings (Egbali & Bakhsh, 2011; Nair et al., 2015)
  - Destruction or pollution of the local environment (Egbali & Bakhsh, 2011; Nair et al., 2015)
  - Outbreaks of epidemic diseases are more probable (Egbali & Bakhsh, 2011)

- **Type of region**: All those involved in tourism

- **Regions**: To be determined during the state of the art analysis

- **Gender-sensitive**: Tourism has generally a positive effect on women, since an opportunity to get a new source of income without the need to commute to other towns or villages. Nevertheless, it also fosters the participation of women in part-time, seasonal and low-income works.
- **Method(s)**: Focus group, Desk research
- **Internal relations** (explained):
- **Possible connection**: Socio-economic component, Socio-ecological & technical component
- **Sources**: Egbali & Bakhsh (2011), Nair et al. (2015)
- **Other comments**: The plausible presence of this factor can be assessed case by case during the state of the art analysis

### *2.2.6. Urban-centred narrative*

- **Code**: C1-F06
- **Description**: This factor is related to the presence in the last two decades of a dominant narrative, which is represented in science (especially in finance and economics), in policymaking, and in the media (mass media, entertainment industry etc.). This narrative puts forward the idea that big cities are the future and that, consequently, territorial interventions should not focus on declining places - as perceived to have a lower potential - but rather on those places that are supposed to be more rewarding (in terms of investments): large and dynamic cities. This led to creating a shared image of "places that matter" and "places that don't matter", in which the latter are often linked to crises in the agricultural and/or industrial sectors, to significant outward migration and brain drain. This imaginary has been reinforced in political and media discourses, with the polarization of votes in election and referendum in Europe (e.g. Brexit) and the US, in which the divide between populist and mainstream parties has been explained with the rhetoric of "places that don't matter". Thus, the belief that there are places that don't matter comes both from within these declining areas – that feel left behind – and from the outside.
- **Examples/Indicators**:
  - A shared feeling of peripheralisation within the territory, i.e. feeling of being left behind (Rodriguez-Pose, 2018)
  - A diffused lack of faith in the future of the territory, i.e. feeling that there is no hope (Rodriguez-Pose, 2018)
  - A diffused feeling of anger toward places that are at the centre of the public discourse, i.e. feeling of being treated unfairly (Rodriguez-Pose, 2018)
- **Type of region**: All
- **Regions**: All
- **Gender-sensitive**: No
- **Method(s)**: Focus Group, In-depth interviews

- **Internal relations (explained)**: Populism, Territorial Stigma (C1-F07), Transfer and Subsidies (C4-F10), Old-time nostalgia (C1-F08)
- **Possible connection**: Socio-political component
- **Sources**: Rodriguez-Pose (2018)
- **Other comments**: The plausible presence of this factor can be assessed case by case with in-depth interviews

### *2.2.7. Territorial stigma*

- **Code**: C1-F07
- **Description**: A "territorial stigma" or "environmental stigma" can be attached to some territory, for its economic, social or environmental feature. Territorial stigmatization is not a static condition or a neutral process, but a consequential and injurious form of action through collective representation fastened on place (Wacquant, et al. 2014). In particular, the environmental stigma refers, an actual or feared negative psychological experience associated with living in a community where the natural resource extraction and/or processing activities are seen as potentially destructive among some groups.
- **Examples/Indicators**: Territorial stigma, as described in the literature has three features (Wacquant, et al. 2014):
  - Presence of Stigma based on the territories criticalities and problems (such as the increase of social exclusion or poverty)
  - The territorial stigma is nationalised and democratised, as the name of these places are examples used in the public discourses and universally renowned for their pejorative features
  - Stigmatised territories are pictured as vortexes and vectors of social disintegration, fundamentally dissolute and irretrievably disorganised
- **Type of region**: All the region dealing with coal
- **Regions**: Plausibly all except Stavanger and Styria (to be verified)
- **Gender-sensitive**: Yes, territorial stigma has gender dimensionsas well as important intersections with class, ethnicity, and religion: For instance, some places are asociated with particular gendered figures such as “the single mother in welfare or the young adult male as instigator of social disorder” (DeKoning & Vollebergh 2019)
- **Method(s)**: Focus Group, Desk research, In-depth interviews
- **Internal relations (explained)**: International immigration (C1-F03) is associated or can increase territorial stigma.
- **Possible connection**: Socio-psychological component
- **Sources**: Wacquant et al. (2014), Frantal (2017), Zhuang et al. (2016)

- **Other comments**: The plausible presence of this factor can be assessed case by case with the state of the art analysis and with in-depth interviews

### *2.2.8. Old-time nostalgia*

- **Code**: C1-D08

- **Description**: Nostalgia is generally mentioned as a sign of dysfunction within the wider political and governance system. It is also described as a contagious factor that is more likely to take hold in some places than others and can work as an "incubator" for "illiberal fantasies and political desires" (Kenny, 2017). This factor can take different shapes: golden era nostalgia, post-welfare melancholia, places nostalgia, etc. For coal and carbon regions specific terms have been produced like coal-fired nostalgia and smokestack nostalgia. Old-time nostalgia has been identified as one of the recurrent imaginaries in political processes like Brexit votes, or US election. It is not only a driver of political messages but involves wider participation in society. It can be considered a source of stress as the present territorial condition is persistently and negatively compared with a symbolic past which is seen as opposed to the present.

- **Examples/Indicators**:
  - Associated with an increased attitude to reject and exclude "the others" (Norocel, 2020; Pickering & Keightley, 2006)
  - Favouring out-group directed anger (Cheung et al., 2017)
  - Resurgence of ethnic nationalism (Schreurs, 2020; Norocel, 2020; Elgenius & Rydgren,2019; Rudacille, 2015)
  - Disruptive potential, e.g. it can disrupt institutional arrangement and governance systems (e.g. Brexit) (Norocel, 2020; Kenny, 2017)
  - Local perception of history as a decline (Kenny, 2017; Angé & Berliner, 2014)

- **Type of region**: All

- **Regions**: All

- **Gender-sensitive**: Old-time nostalgia can be associated with nostalgia on traditionally divided roles among men and women

- **Method(s)**: Focus Group, Desk research, In-depth interviews

- **Internal relations (explained)**: linked with territorial stigma and populism

- **Possible connection**: Socio-political component, Socio-Economic component (Lock-in situation, C4-P01)

- **Sources**: Norocel et al. (2020), Schreurs (2020), Kenny, M. (2017), Elgenius & Rydgren (2019), Pickering & Keightley (2006), Rudacille (2015), Cheung et al. (2017), Angé & Berliner (2014)

- **Other comments**:

### *2.2.9. Top-down (exogenous) development projects*

- **Code**: C1-F09

- **Description**: Across Europe, one of the key coping strategies adopted to deal with the regions that are declining or that are lagging, has been the adoption of top-down development strategies. These strategies have been pursued by creating growth poles aimed at stimulating growth within such declining areas while reducing regional inequalities. The literature shows how in many cases these coping strategies obtained results below the expectations. In certain cases even it became a factor of distress at the territorial level. This top-down approach frequently led to the design and implementation of big and eye-catching, but often superfluous development strategies, that often result in in "white elephants" or "cathedrals in the deserts". Moreover, top-down development projects are often burning a large number of public resources but have been also proven to address only particular interests or views of specific stakeholders of political groups. These interventions can be a source of territorial stress as they may be not aligned with the local tradition and needs, they can be invasive of the built or natural environment, and can create social tensions among different interest groups

- **Examples/Indicators**:
  - Conflict among different interests, or political groups (Rodriguez-Pose, 2018)
  - Invasive modification of the built or the natural environment (Albalate & Bel, 2012)
  - Misalignment with local expectations or way of life (Chavot et al., 2018)
  - Distrust toward central or European authorities (Chavot et al., 2018)
  - Overt opposition (e.g. high-speed train infrastructures) (Albalate & Bel; 2012)

- **Type of region**: All the regions who have been addressed with top-down development projects

- **Regions**: To be assessed during the state of the art analysis

- **Gender-sensitive**: Gender equality discourse is only seldomly present in the top-down regional development practice and project around Europe, as it is still perceived by many stakeholders as a gender-neutral political field. Even when European programs - such as the Structural Funds - requires a gender mainstreaming approach, it has been proved how gender is mainly used as a rhetorical and tokenistic tool. The lack of gender sensitiveness of such programs is a further source of stress at the territorial level, as the structural and infrastructural change promotes do not take into account the gender-differentiated needs of the population.

- **Method(s)**: Focus Group, Desk research, In-depth interviews

  **Internal relations (explained)**: The presence of top-down development project is associated in the literature with factors such as "Transfer and subsidies" (C1-F10), "Populism" (C1-F14).

- **Possible connection**: Socio-ecological & technical component

- **Sources**: Rodriguez-Pose (2018), Chavot et al. (2018), Crescenzi et al. (2018), Albalate & Bel (2012), Oedl-Wieser (2016)

- **Other comments**:

### *2.2.10. Public Transfer and subsidies*

- **Code**: C1-F10

- **Description**: National governments and European Union authorities often make resort to fund transfer and welfare state to mitigate the symptoms of economic and social decline and supporting people living in the regions that are lagging behind. Among the measures more commonly adopted in these cases, are: (i) the creation of public employment as a way to improve the livelihoods of individuals and pump resources in the region; (ii) public transfers based on progressive fiscal system, using funds for maintaining the welfare of disadvantaged areas; (iii) the supply of subsidies for disadvantaged people or economic activities. Very often, these measures do not achieve the expected results, and on the contrary, can constitute a further factor of stress on the territorial system. These measures often have resulted in "assisted economies", incapable of mobilising their true social and economic potential, and in territories dependent on state and/or European fund transfers. The literature on the matter shows that when this modus operandi becomes deeply rooted in a territory, the sense that there are no future increases and make continuous assistance even more necessary.

- **Examples/Indicators**: A set of phenomena related to public transfer and subsidies have been identified by Rodrigues-Pose (2018)
  - Dependence on subsidies and consequent social inaction;
  - Maintenance of networks based on clientelism and connivance between political power and active groups of society
  - Diffused awareness of the situation of dependence
  - Unsatisfactory relation with the territory
  - A shared feeling of lacks of opportunity
  - Resentiment toward other places or territory where public resources or action are concentrated

- **Gender-sensitive**:.There is a growing strand of literature (e.g. Fruttero et al. 2020) showing how different fiscal and economic tools are more or less responsive to gender differences. Such literature highlights some key differences among man and women that can generate differentiated outcomes of such fiscal intervention such as a different initial position in the labour market; the difference in the care activities between man and women; tax systems that generally penalise the secondary earner within the family (women in general). Transfer and subsides developmental strategy generally do not take into consideration such differences and generally are more centred on mitigating the negative effects of ongoing transformations rather than focusing on fostering the unexpressed economic and regional development potential of women.

- **Type of region**: All those regions receiving public transfers and subsidies

- **Regions**: To be further assessed during the state of the art analysis

- **Method(s)**: Focus group, Survey

- **Internal relations (explained)**: The effects of subsidies and transfer, and the related inaction, can be linked to "Territorial Stigma" (C1-F07), "Old-time nostalgia" (C1-F08).

- **Possible connection**: Socio-economic component

- **Sources**: Rodriguez-Pose (2018), Fratesi & Rodriguez-Pose (2016), Fruttero et al. (2020)

- **Other comments**: -

### *2.2.11. Exogenous private investment*

- **Code**: C1-F11
- **Description**: Exogenous capital flows investment is generally seen as a desirable element for supporting employment and growth at the regional level. Nevertheless, such investments of privates or companies may create socio-cultural stress at the territorial level. Exogenous investment flows normally do not take into account the desirable patterns of development of the local community and the role that specific local culture may have as a mediator. Such limits have been highlighted by different strands of literature both in Europe and in the international context, focusing on community-based development (Narayan, 1995), Exogenous development (Slee, 1993), smart villages (Hess, 2018), etc.
- **Examples/Indicators**:
  - Lack of alignment between investments and local attitudes
  - Economic production is disjointed from the territorial culture
  - An increasing feeling of the dependence of the local community
  - Unequal competitiveness with small and medium-sized local businesses
- **Type of region**: All
- **Regions**: All
- **Gender-sensitive**: No
- **Method(s)**: Focus Group, Desk research, In-depth interviews
- **Internal relations** (explained):
- **Possible connection**: Socio-Economic component
- **Sources**: Hess (2018), Slee (1993), Narayan (1995)
- Other comments:

### *2.2.12. Organised crime investments and criminality*

- **Code**: C1-F12
- **Description**: There is a two-way relationship between crime and stress. On the one hand, crime is a factor of insecurity and vulnerability and, as such, it causes social stress in a community. On the other hand, most crimes also occur, at least partly, as a result of stress (individual, but also social - e.g. social exclusion phenomena). In other words, stress and crime are interrelated linearly (e.g., stress causes crime) and in a reciprocal cycle (e.g., victimization inducing stress). Organised crime investments spread across European regions, especially in areas and economic sectors that are in distress and where public funds are foreseen. Such investments distort the local market, threaten the

local social cohesion and are often accompanied by a feeling of insecurity. It has been registered in the literature as coal mining activity can be infiltrated by a criminal organisation.

- **Examples/Indicators**:
  - Diffused awareness or suspicious of political and economic infiltration
  - Distortion in the local business market in certain sectors
  - Increased informalisation of economic activities
  - Blurring boundaries between licit and illicit activities (or even spreading of illicit activities)
  - Violence episodes
  - Presence of Environmental crimes
  - A feeling of insecurity in the local community

- **Type of region**: All

- **Regions**: All

- **Gender-sensitive**: The literature shows how crime is a gender-sensitive activity (Belknap, 2020), and it is plausible to assume that the presence of crime investment may have differentiated effects on man and women (Reitano-Hunter, 2018). Notwithstanding that, the scoping review of the literature has not found more specific information on this issue.

- **Method(s)**: Focus Group, Desk research, In-depth interviews

- **Internal relations (explained)**: Crime investments can be connected with the presence of "Transfer and subsides" (C1-F10) and with "Top-down project" (C1-F09)

- **Possible connection**: Socio-political

- **Sources**: Mirenda et al (2019), Dugato et al. (2020), Reitano & Hunter (2018), Savona & Berlusconi (2015), Belknap (2020)

- **Other comments**:

### *2.2.13. Disinvestments*

- **Code**: C1-F13

- **Description**: The disinvestment from fossil fuel can be referred to two different phenomena: a) disinvestment campaign, conducted by environmentalist movements to encourage public and private investors to divest from coal and other fossil fuels; and b) public disinvestment, adopted by regional, national and European actors, who are not supporting or funding fossil fuel industries and related services. The coal extraction and coal power generation industries have been the main one touched by disinvestment phenomena in the last years. The divestment aims not only to shortcut the funding to the current activities but to prevent further investments in the sector. This trend has been accelerated with Covid-19 crisis. Besides the divestment from fossil fuels, private and public disinvestment in the regional economy happens also when the region registers a decline in the population and a reduction of its workforce as these are standard parameters adopted for assessing the productivity of regional investments.

- **Examples/Indicators**:

- Presence of unfinished infrastructure, building or facilities
- Interruption or sudden revision of regional development plans, or even national reforms
- Business closure, size reduction or conversion

- **Type of region**: All those based on coal extraction or deployment
- **Regions**: All except Stavanger and Upper Styria
- **Gender-sensitive**: No
- **Method(s)**: Focus Group, Desk research, In-depth interviews
- **Internal relations** (explained):
- **Possible connection**: Socio-economic component, Socio-political component
- **Sources**: Bergman (2018), Henry et al. (2020), OECD. (2010).
- **Other comments**:

### *2.2.14. Populism*

- **Code**: C1-F14
- **Description**: The so-called populism is a political force that is spreading in Europe and worldwide. While in western countries it has been particularly visible starting from 2016 with the Brexit referendum and the election of Donald Trump, but it has already spread before in other parts of the world (Latin America, Thailand, etc.). This so-called populism generally hinges on the figure of a charismatic leader, and it implies a declared intention to reverse global roles, that has been highlighted as a global drive toward deglobalisation. The spreading of populism has been particularly strong in territories that have suffered long term decline or that are lagging behind, such as the areas experiencing decades of deindustrialisation and job losses. The so-called populism is based on territorial inequalities rather than on inequalities among individuals. With its subversive nature populism is reflected at the social level with different forms of strains as the outcome of socio-cultural stress.
- **Examples/Indicators**:

- Increasing societal conflicts, that in some cases can also become violent (or even armed conflicts)
- Visible and symbolically represented social divisions (e.g. Yellow vest, exposition of flags or other political symbols, etc.)
- Conflicts on feminist and/or gender-friendly policies and social rights
- Widespread diffusion and expression of resentment feelings
- Anti-science attitudes and related conflicts at the local level

- **Type of region**: All
- **Regions**: All
- **Gender-sensitive**: The populist radical right has taken control over the conservative agenda on gender issues, by fostering a patriarchal and heteronormativity vision of the society, and by

supporting or creating anti-gender mobilizations. In populist movements, gender and religion have been used as criteria to identify the people of the 'heartland' and the outsider groups (Farris, 2017). Empirical studies have demonstrated that compared to almost all other parties, populist radical right parties draw more votes from men than from women. Several interpretations of this gap are offered in the literature, including considering populism as a genderised discourse (Spiering, 2017).

- **Method(s)**: Focus Group, Desk research, In-depth interviews
- **Internal relations (explained)**: This factor is associated with "Urban centred narrative", "Old-time nostalgia", "Subsides and transfer"
- **Possible connection**: Socio-political component
- **Sources**: Rodriguez-Pose (2018), Latour (2018), Gordon (2018), Farris (2017)
- **Other comments**:

### *2.2.15. Global environmentalism*

- **Code**: C1-F15
- **Description**: Globalism ideology is rooted in the concept of Global Commons and everyone's right of access to them. This led to a new globalised environmental ideology, which in its moderate interpretation has become already an almost mainstream value on the global level. The climate crises have accelerated this trend and new forms of global environmentalism are spreading all around Europe and beyond (e.g. Fridays for future, extinction rebellion). In the absence of a supranational authority able to redistribute advantages and disadvantages of the transition toward a more environmentally sustainable society, the spreading of global environmentalism can be a factor producing a set of tensions and conflicts also at the local level. This is particularly true for coal and carbon-intensive regions, which are exposed to greater pressure for change. Environmentalism is generally exercised with pacific and non-violent actions, based on persuasion with symbolic, provocative or demonstrative actions, but also with disobedience, or even illegal actions.
- **Examples/Indicators**:
  - Conflicts and/or tensions between social, economic and ecological sustainability goals
  - Conflicts and/or tensions related to generational justice, e.g. between young people and older population within the community
  - Conflicts and/or tensions related to territorial justice, e.g. the regional community can perceive the transition as a disadvantage
  - Site-specific conflicts or tensions (conflicts related to biodiversity, coastal area, air quality or noxious pollutants)
- **Type of region**: All
- **Regions**: All
- **Gender-sensitive**: No
- **Method(s)**: Focus Group, Desk research, In-depth interviews

- **Internal relations** (explained):
- **Possible overlap**: Socio-political component
- **Sources**: Scheidel et al. (2020), Barabanov & Savorskaya (2018), Latour (2018)
- **Other comments**:

### *2.2.16. Digital divide*

- **Code**: C1-F16
- **Description**: The digitisation of the economy and social life put the peripheral or rural region in the position of disadvantage. From the supply side, these areas are more difficult to reach, and their reduced population (compared with other areas) makes the investment in these infrastructure low rewarding for the tech companies. On the demand side, peripheral areas suffer from lack of skills and knowledge regarding digital technologies, which limits their possibilities for innovative service provision, business or customer use. Therefore, rather than keeping on top of technological development, rural and peripheral areas are continuously in a situation of catching up with urban areas.
- **Examples/Indicators**: Not keeping up with digital developments can lead to:
  - Digital exclusion,
  - Lagging rural development,
  - Economic decline
  - Bureaucratic barriers and lower services
  - Increased isolation of the ageing population
- **Type of region**: All with some exception to be assessed during the case studies
- **Regions**: All except Stavanger, Krakow Metropolitan Area
- **Gender-sensitive**: Studies exploring labour market issues from the perspective of digitisation and the gender disadvantages that women experience are slowly emerging (Adebiyi, 2019). Many believe that the ongoing digital transformation, by allowing more flexible working methods, will strengthen the position of women in the labour market, not least because it makes it easier to combine paid work with caring responsibilities, which are still more often assumed by women (OECD, 2017). However, different studies show that while the transformation of the workplace towards a more flexible functioning is not inevitably in contradiction with the broader goal of achieving gender equality, without vigilance, flexibility risks compromising equality in the short and long term (Schultz, 2009; Faith 2017).
- **Method(s)**: Focus Group, Desk research, In-depth interviews
- **Internal relations (explained)**: Youth outmigration (C1-F01), Urban centred narrative (C1-F06)
- **Possible overlap**: -
- **Sources**: Vironen & Kah (2019), ESPON (2017)

- **Other comments**:

### *2.2.17. Automation*

- **Code**: C1-F17

- **Description**: There is strong evidence that digital technologies are resulting in greater divisions between large and small urban areas, and that future automation disruptions will further exacerbate regional and local disparities. Automation and mechanisation already challenge sectors like extraction, industries, agriculture, commerce, services. Such changes create a broad array of socio-cultural stress at the territorial level.

- **Examples/Indicators**:
  - Creation of new scarcely regulated jobs;
  - Unstable under-employment contracts also called zero-hours contracts;
  - Development of a high-skill/low-skilled bifurcated labour market;
  - Conflicts around the control of digital data;
  - A shift in demand for skills, leading to a potential labour market mismatch
  - Loss of competitiveness of local SMEs

- **Type of region**: All

- **Regions**: All

- **Gender-sensitive**: To be further investigated

- **Method(s)**: Focus group, Desk Research

- **Internal relations** (explained):

- **Possible overlap**: Socio-ecological & technical

- **Sources**: Petropoulos et al. (2019), Crowley & Doran (2019), Rotz et al. (2019), Novak et al. (2018)

- **Other comments**:

### *2.2.18. Global Warming - natural hazards*

- **Code**: C1-F18

- **Description**: Climate change is expected to cause more frequent droughts and floods, altering the supply of water to mining sites and disrupting operations. Global warming produces stress not only at the individual level but also at the social and community levels. This issue especially regards environmental (and social) perturbations such as cyclones, floods, heatwaves and other natural hazards that global warming provokes. Moreover, at this level, these hazards provoke real disasters impacting people social life and governance systems.

- **Examples/Indicators**:
  - Social disorder due to disasters related to natural hazards
  - Mistrust towards local authorities

- Feeling of insecurity
- Business closure or restriction
- Increased rates of psychic illnesses and suicides

- **Type of region**: All

- **Regions**: All, to be assessed case by case

- **Gender-sensitive**: Women tend to have fewer opportunities to protect themselves from global warming in the short- and long-run, as they often have fewer financial resources/securities, less access to information and sometimes less access to networks (sometimes also more than men). While women tend to be more affected by the negative impacts of global warming, they are less involved in decision making for mitigation and adaptation measures /policies. (Spitzner et al., 2020)

- **Method(s)**: Focus group, Desk research, Survey

- **Internal relations** (explained):

- **Possible connection**: Socio-Ecological & Technical

- **Sources**: Reyes-García et al. (2016)

- Other comments:

### *2.2.19. Pandemic*

- **Code**: C1-19

- **Description**: The Pandemic is undoubtedly a form of socio-cultural stress at the territorial level. It has been highlighted that the pandemic can either accelerate and/or highlight some stress phenomena that were already present. It has been shown that the territorial consequences of the pandemic - included the socio-economic ones - are not the same everywhere and that a broad array of variable intervenes, such as the presence of more exposed economic sectors (e.g. tourism), the national responses to the emergency, the financial vulnerability of each local or sub-national government.

- Examples/Indicators:
- Social conflicts on pandemics management
- SME failure
- A strong decrease in revenues, combined with a continuous increase in expenditure (e.g. social services) in local and regional administration can create a "scissor effect" leading to put local and subnational government into debt
- The conflict between different levels of governance (e.g. national VS regional)

- **Type of region**: All

- **Regions**: All

- **Gender-sensitive**: The covid-19 pandemic creates new forms of vulnerabilities for women and their health and exacerbates social inequalities and disparities. These include gender roles, economic

and food security, violence, work pressures, and access to health and health facilities. These issues have important implications for women's physical and mental health (Simba and Ngcobo, 2020)

- **Method(s)**: Focus group, Survey
- **Internal relations** (explained):
- **Possible connection**:
- **Sources**: Power (2020), OECD (2020),
- **Other comments**:

# 3. Literature overview

## 3.1. Overview

As it has been explained in the previous paragraphs of this short report (see Para 1.2.1, and 1.2.2) the scoping review of the literature spanned across many different study areas, that have been organised around the 6 dimensions of the global cultural flows (the 6 scapes). Moreover, the scoping review of the literature focused on those scientific papers or texts reporting empirical results related to territories that can be assimilated to coal and carbon-intensive regions as they potentially are affected by similar de-territorialisation dynamics.

The scoping review of the literature by crossing territorial and thematic keywords has led to refer to 77 papers for the description of the factors. Following the six branches of the Socio-Cultural Stress (SCS) tree, the papers used for the factors' description have been divided across six different clusters. In each cluster, a set of papers focused on gender dimension have been identified with the support of WECF A quantitative overview of the scoping review of the literature conducted under this component is provided in the table below.

**Table 1** - *Quantitative overview of the literature sources adopted for the description of the factors*

| Cluster | Number of factors | Number of sources |
|---|---|---|
| **Ethnoscape** | 5 | 24 |
| **Mediascape** | 3 | 13 |
| **Financescape** | 5 | 16 |
| **Ideoscape** | 2 | 9 |
| **Technoscape** | 2 | 10 |
| **Naturescape** | 2 | 5 |
| **Total** | 19 | 77 |

Moreover, a set of 10 papers have been used for the theoretical basis and for driving the approach, that can be considered a 7th theoretical cluster of the literature review.

The different clusters of literature examined are synthetically described below.

## 3.2. Ethnoscape cluster

This cluster of paper can be articulated into three different streams of literature. The first streams relate to research and studies focused on **specific types of migration**, such as youth migration (Petersen & Gram**,** 2017; Makkai et al., 2017; Gruber & Scorn, 2019; Jones, 2004; McLaughlin, 2014), migration of older people (Zaiceva, 2014; UNECE, 2016; Warnes & Williams, 2006; Pennington, 2013), in-migration in rural and peripheral areas (Gauci, 2020), return migration in European countries (Lesińska, 2013; Karolak, 2020, Anacka & Wójcicka, 2019; Kleinepier et al., 2015; Evtimova-Ivanova, 2012; Hausmann & Nedelkoska, 2018), presence of refugees and asylum seekers (Galera et al., 2018), migration and outmigration of women (Duda-Mikulin, 2018; Leibert & Wiest, 2016; Leibert, 2016). The second stream is related to the literature on **regional and local development**, which also report information of the impacts of migration, including cross-regional or pan-regional European studies (Power, 2018), and country-level studies (Threadgold et al., 2008). The last stream is related to papers focused on the **territorial impacts of Tourism**, including studies conducted outside Europe (Egbali & Bakhsh, 2011) and within Europe (Nair et al., 2015).

## 3.3. Mediascape cluster

This cluster can be articulated into different streams of papers: the first one related to **urban studies**, reviewing the dominant narratives on cities both in economics (Rodriguez-Pose, 2018; Frick & Rodríguez-Pose, 2018) and in planning (Zeiderman, 2008). The second stream is related to **studies of stigma**, and included theories of territorial stigma (Wacquant et al. 2014), the empirical literature on environmental stigma (Zhuang et al., 2016), and studies on stigma in the coal intensive regions (Frantal, 2017). The third and last stream of the literature of the mediascape cluster is **related to nostalgia**, and it spans across different perspectives, including studies of nostalgia as a phenomenon at the intersection of policy and culture (Norocel et al., 2020; Kenny, 2017), studies on nostalgia and resurgence of right-wing nationalism in some European countries (Schreurs, 2020; Elgenius & Rydgren, 2019); on the nostalgia related to coal and industry (Rudacille, 2015) and on Nostalgia as a theoretical category (Pickering & Keightley, 2006; Angé & Berliner, 2014).

## 3.4. Financescape cluster

This cluster collects different streams of literature. Many texts related to **regional development studies** highlight the perverse or unwanted effects of developmental policies, in general (Rodriguez-Pose, 2018, Fratesi & Rodriguez-Pose, 2016) or in transport sectors (Crescenzi et al., 2018; Albalate & Bel, 2012) or respect to gender equality (Oedl-Wieser, 2016, Fruttero et al., 2020). The second set of paper is related to **non-conventional development strategies**, such as smart villages (Hess, 2018), endogenous development (Slee, 1993), community-based development (Narayan, 1995) and highlights the risks connected with models of development driven from outside (Chavot et al., 2018). The third stream of paper is related to studies on **territorial infiltration of organised crime**, either in Italy (Mirenda et al, 2019 and Dugato et al., 2020), and in an international comparative analysis (Reitano & Hunter, 2018; Savona & Berlusconi, 2015). Finally, a last stream of literature focuses on the **international outlook on coal divestment strategies** (Bergman, 2018; Henry et al., 2020).

## 3.5. Ideoscape cluster

This cluster collects different streams of literature. The first one includes papers dealing with the connection between the surge **of populism and de-territorialisation** (Rodriguez-Pose, 2018; Latour, 2018; Gordon, 2018). The second is related to **gender and anti-gender ideologies** (Farris, 2017; Grunow et al. 2018; Gallo 2020; Spiering, 2017). The last one is related to **environmental ideologies**, addressing the conflicts between environment and the social (Barabanov & Savorskaya, 2018) or focusing on the different types of conflicts connected with environmental battles at the local level (Scheidel et al., 2020).

## 3.6. Technoscape cluster

In this cluster, two main streams of literature have been reviewed and used for the description of the factors. The first one is related to **digitisation** and includes a focus on the digital divide of rural, peripheral or internal regions (Vironen & Kah, 2019; ESPON, 2017; Petropoulos et al., 2019; Novak et al., 2018) and on the impact of digitisation on gender inequality (Adebiyi, 2019; OECD, 2017; Schultz, 2009; Faith 2017) and the other related to empirical studies on automation (Crowley & Doran, 2019; Rotz et al., 2019).

## 3.7. Naturescape cluster

In this cluster two main streams of literature have been reviewed and used for the description of the factors: one related to **local perception of climate change** (Reyes-García et al., 2016), including also the unbalanced effects of global warming on women (Spitzner et al. 2020) and the other related to **territorial effects of the pandemic** (Power, 2020; OECD, 2020) including also gender aspects (Simba & Ngcobo, 2020).

## 3.8. Theoretical cluster

Finally, a set of papers have been used as the main reference for the **socio-cultural stress theory**, in its original formulation (Bertrand, 1963; Merton & Merton, 1968), and for actualising it in the light of the theory of fields (Bourdieu and Wacquant, 1992; Fligstein & McAdam, 2012). Moreover, the literature on **globalisation cultural flows** (Appadurai, 1990, 1995, and 1996) has been adopted for the identification and classification of the stress factors. Finally, a set of studies used in the literature review **focuses on territory's definition**, under the lenses of de/re-territorialisation (Deleuze & Guattari, 1988), territorial innovation (Camagni, 1991) and geographical reflections (Elden, 2010)

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# ANNEX 2

## Socio-psychological Component

Short Report on Key Factors, Dynamics and Patterns

# Document Control Sheet

| Project Title | |
|---|---|
| **Work package** | **WP1** |
| **Task** | **1.6 Socio-psychological key factors, dynamics and patterns** |
| **Number of pages** | **41** |
| **Main author** | **Ricardo Garcia Mira, Nachatter Singh Garha (UDC)** |
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# Versioning and Contribution History

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# 1. The Socio-Psychological Component

## 1.1. Introduction

The socio-psychological component studies the socio-psychological impacts of the closure of coal-mines and carbon intensive industrial units (ongoing shift towards clean energy sources, also referred as energy transition) on the lives of individuals who are directly or indirectly involved in the carbon intensive activities in thirteen different coal and carbon-intensive (C&CI) regions of the European Union (EU). The economic, social and political uncertainties caused by the closure of mines and coal-based industrial units create enormous socio-psychological stress for the local population, who perceive it as an existential threat to their way of life and to their primary source of livelihood. This stress at individual level may compel people:

- to reunite and resist against this transition that may lead to the postponement of the closure of coal and carbon intensive activities, which in turn will contribute to the environmental degradation and climate change; or
- to protest against the local governments and environmentalist groups, which may lead to socio-political unrest and rise of populist politics in these regions; or
- to give up the fight and live on the social security system, which may incur a very high economic and social cost for the society, and is also not a viable solution for all people and governments in different regions; or
- to emigrate from these regions in search of employment opportunities and better living elsewhere, which may lead to the de-population and de-territorialisation of these regions, and will result into the loss of territorial identity of the people; or
- to reinvent themselves, learn new skills and search for new occupational niches, which may accelerate the process of re-territorialisation in these regions.

## 1.2. Component key feature

The socio-psychological component will focus on:

- The impacts of the phase-out of coalmines and closure of related industrial units on the socio-psychological well-being of the people, who were directly or indirectly involved in the carbon-intensive industry in the 13 selected regions of the EU.
- The factors, dynamics and patterns related to the de-/re-territorialisation of the coal and carbon-intensive regions under transition.
- The transformation of the territorial/local identity of the affected people and regions under transition.
- Individual challenges and coping strategies to cope with the socio-psychological stresses caused by the transition to clean energy, especially those related to the de/re-territorialisation of the coal and carbon-intensive regions.

The main research questions are:

- What are the principal socio-psychological challenges people (affected groups) are facing in the C&CI regions under transition? Which of these challenges are most relevant to the transition to a more sustainable society in these regions?
- What is the role of socio-psychological stress in intensifying the de-territorialisation processes in the C&CI regions, including aspects such as outward migration and rise of populism?
- What are the coping strategies adopted by the people to deal with socio-psychological stress in the C&CI regions? And which of these strategies are more effective in the re-territorialisation processes?
- Which socio-psychological factors have the greatest predictive power of disconnection between the community and the territory (also called de-territorialisation)?
- What is the level of individual resilience and optimism among different affected communities in coal and carbon-intensive regions and how does it affect the de/re- territorialisation of these regions?
- What policy responses will be needed to increase the resilience of affected communities?
- What policies or combination of policies would be the most appropriate to trigger, support and accelerate the re-territorialisation process of the C&CI regions in transition?

### 1.3. Component synthetic description

- **Component lead partner:**Universidad de A Coruña (UDC).
- **Other partners:** UAIC, K&I, NTNU
- **Overall approach:**Psychometric Approach (quantitative)
- **Domain of enquiry:** Individual cognitive and emotional processes related to territorial change. The focus will be on:
    - Socio-Psychological stress and challenges for the individual actors (from different affected communities), who are directly or indirectly related to the coal and carbon phase out in thirteen different regions in the EU;
    - Individual resilience factors counteracting the stressors;
    - The individual coping strategies adopted to respond to this energy transition;
    - The impact of this transition on the decision to stay or migrate and its consequences for the territory (de/reterritorialization) and the people (territorial and social identity) of these regions.
- **Theory:**
    - Place attachment theory (Altman and Low, 1992);
    - Social identity theory (Tajfel and Turner, 1979; 1986);
    - Social learning theory (Bandura, 1971).
- **Primary method:** Survey
- **Secondary methods:** Interviews and Focus group
- **Case diversification:** There will be very limited diversification (mainly due to contextual factors in different regions) in selected case studies because on the ‘psychological level’ we assume that there

are very few structural differences between factors relevant for people (different actors) in the different study regions.

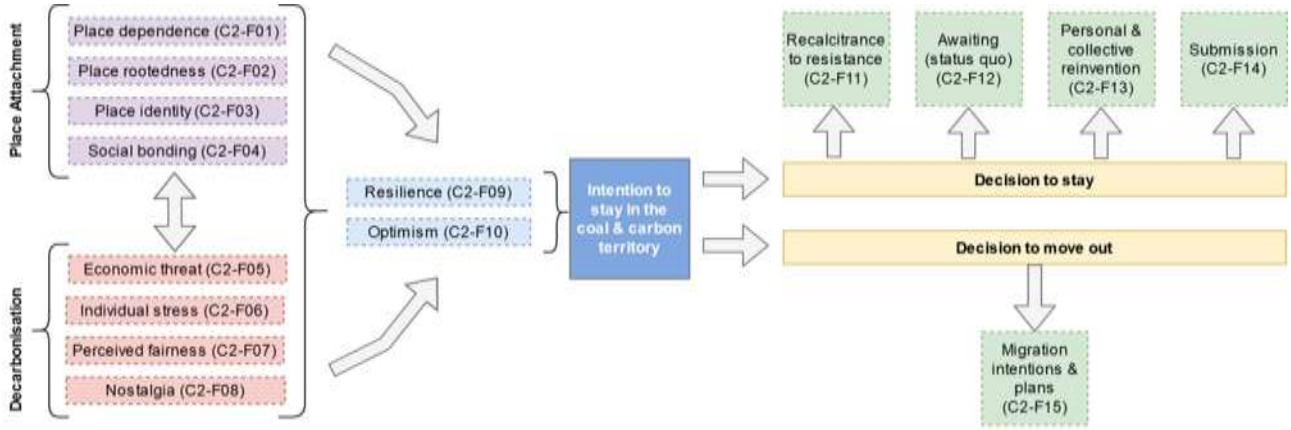
- **Research area definition:**Socio-psychological well-being of the people from different affected communities, which are directly or indirectly affected by the coal and carbon phase-out or energy transition. Affected communities will be identified in all selected regions, with some pre-defined criterion based on contextual factors.

# 2. Factors, Dynamics and Patterns

## 2.1. Overview

For this study, we have identified seven individual and five contextual factors that can determine the impact of coal and carbon phase-out on the socio-psychological well-being of affected people in C&CI regions. We have also identified five dynamics and seven patterns that may characterize different C&CI regions in the near future (Figure 1). All these factors, dynamics and patterns are discussed below:

**Figure 1 – Factors, dynamics and patterns that can determine the impact of coal and carbon phase-out on socio-psychological well-being of affected people in carbon-intensive regions.**




*Source: Own elaboration.*

## 2.2. Constructs and Factors related to Socio-psychological component

**Construct: Place Attachment**

The concept of place attachment defines the ways in which people connect to various places, and the effects of such bonds in identity development, place-making, perception, and practice (Altman and Low 1992). It has been used by scholars to understand the bonds humans share with the physical environment. It is often explained in terms of its affective, cognitive and conative elements (Scannel and Gifford, 2010). The affective element refers to humans' emotional attachments to place. The cognitive element has generally been considered in terms of the thoughts, knowledge, beliefs, and memories of places of interest. The conative or behavioural facet reflects individuals' desire to maintain connections to place and is occasionally evidenced in territorial responses. Brown and Perkins (1992: 284) pointed out that "Place attachment involves positively experienced bonds,

sometimes occurring without awareness, that are developed over time from the behavioural, affective, and cognitive ties between individuals and/or groups and their sociophysical environment. These bonds provide a framework for both individual and communal aspects of identity and have both stabilizing and dynamic features". It is affected by socio-demographic characteristics of people (Williams and Roggenbuck, 1989, Altman and Low, 1992, Gustafson, 2001); environmental experiences including people's type of involvement with place, and degree of their familiarity with a place; people's expertise or knowledge about place, religion and culture, length of association, place dependence, place satisfaction, sense of belonging and place affective (Stokols and Shumaker, 1981, Proshansky et al., 1995, Williams and Roggenbuck, 1989, Shamai, 1991, Steadman, 2003, Raymond et al., 2010).

Place attachment can be paradoxical, as 'place attachments lead us to stay and protect what we cherish most in our communities and to invest time, energy, and money to improve that with which we are dissatisfied' (Perkins, Hughey and Speer, 2002, p. 41). Therefore, the place attachment can be described in terms of change-oriented and stability-oriented place attachment. While the former aims for improvement and adapts to external changes, the latter can result in protective behaviour, nostalgia, and fear of loss or change of existing place aspects (Zwiers, et al. 2018).

Higher level of place attachment...

- serves as a defence against identity crises in the periods of transitions between successive developmental stages (Hay 1998).
- increases place consciousness among resident population and helps to build strong place identity (Proshansky, Fabian, & Kaminoff, 1983).
- plays a role in fostering individual, group, and cultural self-esteem, self-worth, and self-pride (Low and Altman 1992).
- contributes to civic activity on behalf of one's place of residence, in the form of sustainable behaviour (Pol, 2002; Uzzell, Pol, & Badenas, 2002).
- improves individual and collective behaviour towards environment conservation (Vorkinn & Riese, 2001).
- is negatively correlated with pro-environmental attitudes and supportive of the motivation to preserve the status quo in places of residence (Bonaiuto, et al. 2002)

**Place attachment can be measured through following factors:**

### *2.2.1. Place dependence*

- **Code:** C2-F01
- **Type:** Factor
- **Factor Description:** Place dependence arises from a positive evaluation of a place on the basis that it meets an individual's needs and allows them to achieve their goals (Shumaker & Taylor, 1983). In previous studies, it is conceptualized as the functional attachment to the place (Stokols and Schumaker 1981; Schreyer, Jacob, & White, 1981). It reflects the importance of the place in

providing features and conditions that support specific objectives or desirable activities (Brown and Raymond, 2007). It highlights the role of physical environments in the attachment to the place, that is providing some comfort and the resources with the artificial and natural environment supporting a person's goals (Alrobaee and Al-Kinani 2019). The term dependence refers to the fact that the attachment to the place is caused by the place basic value in achieving the desired objective (Gurney et al. 2017). Place dependence can be determined by Place quality and Place expectation.

- **Examples/Indicators:** A higher Place dependence level...
  - tends to improve place identity, which in turn has a positive influence on ecologically responsible behaviour (Vaske and Kobrin 2001; Williams and Vaske 2003).
  - increases the extent of place attachment (Brown and Raymond 2007; Chow and Healey 2008; Scannell and Gifford 2010).
  - sensitize people about environmental protection (Ramkissoon, et al. 2012).
- **Type of region:**Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes, previous studies show that
  - women report being more attached to their homes than men (Hidalgo and Hernandez, 2001).
  - attachment to the relational community is higher among women because of their social role: the responsibility for childcare and home management binds them to local interaction (Tartaglia 2006).
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** It is related to other factors, such as place attachment, resilience, place quality, social security system, political regime, perceived fairness, technology, economic development.
- **Possible overlap:** Socio-economic, Socio-political, Socio-cultural,Socio-ecological, Socio-technical.
- **Sources:**Shumaker, S. A. and Taylor, R. B. (1983).
- **Other comments:** Place dependence is also associated with several sub-factors, such as self-efficacy, motivation, knowledge.

### *2.2.2. Place Rootedness*

- **Code:** C2-F02
- **Type:** Factor
- **Factor Description:** Tuan (1980: 4) characterizes place rootedness as a very strong and focused bond that ‘in its essence means being completely at home – that is, unreflectively secure and comfortable in a particular location’. Stegner (1992: 2) captures the extreme elements of rootedness when he states that ‘a place is not a place until people have been born in it, have grown up in it, lived in it, known it, died in it –have both experienced and shaped it, as individuals, families, neighbourhoods, and communities over more than one generation.’Rootedness is an unconscious attachment to a place due to familiarity achieved through continuous residence -perhaps that of a

familial lineage that has known this place in the years before the current resident (Giuliani 2016). Hay (1998) found that ancestral and cultural connections are important to the development of a rooted attachment to place.

- **Examples/Indicators:**Higher level of Place rootedness...
  - Foster emotional bonds with territory (Giuliani 2016).
  - discourages emigration and contributes to return migration, as people higher level of place rootedness like to return to their roots (Rowles 1983).
- **Type of region:**Applicable in all regions.
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes,previous studies have found that
  - Women are more sentimental about places, than men, who are less comfortable expressing their emotions (Cortés 2014).
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** It is related to other factors, such as place attachment, resilience, political regime, perceived fairness.
- **Possible overlap:** Socio-economic, Socio-political, Socio-cultural
- **Sources:** Tuan, Y. F. (1980).
- **Other comments:** Place rootedness is also associated with several sub-factors, such as place memory, sense of place, place familiarity, place belonging.

### *2.2.3.Place Identity*

- **Code:** C2-F03
- **Type:** Factor
- **Factor Description:** Place-identity reflects the extent to which physical and symbolic aspects of the place contribute to one's sense of self or identity. It is a core concept in the field of environmental psychology that proposes that identities form in relation to environments and incorporates elements related to the public image of place (Uzzell, Pol, & Badenas, 2002). The term 'Place identity' was introduced by environmental and social psychologists Proshansky et al. (1983), who explained it as a sub-structure of a person's self-identity, which consists of the knowledge and feelings developed through daily experiences of physical spaces. Later, it is also referred as a dynamic interconnection of the internal (residents, businesses and decision makers) and external (tourists, investors, potential residents, public institutions, etc.) opinions of a place. A sense of place identity derives from the multiple ways in which place functions to provide a sense of belonging, construct meaning, foster attachments and mediate change.
- **Examples/Indicators:** Strong place identity...

- fosters pro-environmental attitudes, which in turn promote voluntary cooperation and participation in collective program for the protection of the environment, job creation and the well-being of the community (Hernández et al. 2010; Kyle et al. 2013; Uzzell et al. 2002; Carrus et al. 2005).
- prevent negative environmental perceptions (Bonaiuto el al. 1996).
- increases perception of naturalness (Knez et al. 2018).
- promote people to preserve the unique identity of their region (as people in coal mining regions feel threatened about the loss of their regional identity with this energy transition) (Hernández et al. 2007; Lewicka 2008).
- increases people's social commitment and satisfaction regarding improvements made in their neighbourhood or region (Anton and Lawrence 2014; Manzo and Perkins 2006).
- strengthening the commitment of residents to improve their homes and neighbourhoods (Brown et al. 2003).

- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes, previous studies have found that
  - Women are more attached to their homes than men (Hidalgo and Hernandez, 2001, Rollero and De Piccoli, 2010).
  - Women report stronger pro-environmental views and concern about environmental problems than do men (Xiao and McCright 2015).
  - Women are more sentimental about places than men, who are less comfortable expressing their emotions (Cortés 2014).
  - Women may also be more likely to socialise within their local area as it is often women who spend more time with children (Anton and Lawrence 2014).
  - In Germany, women are proportionately less likely than men to get involved voluntarily and publicly, but women are much more likely than men to care for the children of neighbours, neighbours, friends or acquaintances. The existence of social support is particularly important for women to carry out voluntary work (Simonson, Vogel and Tesch-Römer, 2017, p. 253 & 637)
  - Place identity /bondedness through community engagement: Higher share of community engagement among men than among women, but women tend to do more care and nursing community engagement than men (Simonson, Vogel, Tesch-Römer, 2014)
- **Primary Method:** Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** It is related to other factors, such as place attachment, resilience.
- **Possible overlap:** Socio-cultural, Socio-political
- **Sources:** Proshansky, H., Fabian, A. K., and Kaminoff, R. (1983).
- **Other comments:**Place Identity is also associated with several sub-factors, such as place identification, environmental identity, regional identity.

### *2.2.4.Social Bonding*

- **Code:** C2-F04
- **Type:** Factor
- **Factor Description:** Social bonding is the feelings of belongingness or membership to a group of people, such as friends and family, as well as the emotional connections based on shared history, interests or concerns. It is the degree to which an individual is integrated into the society. It also includes social bonding to the school, to the workplace and to the community. Social Bond theory was given by Hirschi in 1969.He presented four social bonds which promote socialization and conformity: attachment, commitment, involvement and belief. Attachment is the affective identification an individual has with parents, teachers, and peers. Involvement represents the time one spends in conventional activities. Commitment to conventional lives and activities is the third component of the social bond. Belief, measures one's support of general social norms and public laws.

  Perkins and Long (2002) referred to the social connections in place as *social bonding* or the feelings of belongingness or membership to a group of people, as well as the emotional connections based on shared history, interests or concerns. Kyle and Chick (2007) highlighted the importance assigned to place experiences shared with family and close friends on the development of place meanings within different contexts. Kyle et al. (2005) developed a scale for measuring social bonding in terms of the social relationships. It explicitly addressed the role of community as the intermediary between individuals and the natural environment, as proposed by Gustafson (2001) and reinforced by Sampson and Goodrich (2009).
- **Examples/Indicators:** Strong Social bonds...
  - in the neighbourhood raise local attachment (Kohlbacher et al. 2015).
- **Type of region:**Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Hirschi's theory of social bonding suggests that social controls are gender neutral. However, previous studies have found that
  - girls' relational socialization and gendered social bonds impact their involvement in violence (Steffensmeier and Allan 1996).
  - women are socialized to be more relational and focused on the cares and feelings of others than men (Gilligan 1982).
  - girls and boys differ in their “preference for risk” which is acquired, through gender differences in affective bonding (Hagan et al. 1987).
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group.
- **Internal relations (explained):** It is related to other factors, such as place attachment, resilience, social and cultural capital, social security system.

- **Possible overlap:** Socio-economic, Socio-political, Socio-cultural
- **Sources:**Hirschi, T.W. (1969).
- **Other comments**: Social bonding is also associated with several sub-factors, such as individual values, trust, sense of belonging, etc.

**Construct: Decarbonisation threats**

Decarbonisation threats include all risks and vulnerabilities created by the process of decarbonisation in the coal and carbon intensive regions. These can be measured through following factors:

### *2.2.5.Perceived Economic Threat*

- **Code:** C2-F05
- **Type:** Factor
- **Factor Description:**Accumulated empirical evidence has mostly underlined the deleterious psychological effects, in terms of reduced psychological well-being of perceived economic threat in times of economic strain and uncertainty, as those that presumably characterize the Coal and Carbon intensive regions in transition. Economic threat motivates social psychological responses to restore or maintain a sense of control and self-esteem, thwarted under conditions of personal or collective economic crisis. Depending on the circumstances such responses can be either "prosocial" or leading to out-group directed anger (especially when such threats are perceived also at a symbolic level).
- **Examples/Indicators:** Higher level of perceived economic threat...
  - could instigate destructive or potentially negative psychological responses (Fritsche and Jugert 2017).
  - may engender predominantly disruptive psychological responses(Alonso-Ferres et al 2020).
  - might be connected with a higher inclination to engage in prosocial behaviour (Alonso-Ferres et al 2020).
- **Type of region:** Applicable in all regions.
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes.
- **Primary Method:** Yes.
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** It is related to other factors, such as place attachment, resilience, political regime, perceived fairness.
- **Possible overlap:** Socio-economic, Socio-political, Socio-cultural
- **Sources:** Fritsche & Jugert (2017).
- **Other comments:** None.

### *2.2.6.Individual Psychological Stress*

- **Code:** C2-F06
- **Type:** Factor

  **Factor Description:** Stress is a natural physical and mental reaction to life experiences. Everyone expresses stress from time to time. Anything from everyday responsibilities like work and family to serious life events such as a new diagnosis, the death of a loved one, or job loss can trigger stress (Kirsh et al. 2014). The concept of stress lacks a clear definition.People have very different ideas with respect to their definition of stress. Probably the most common is, “physical, mental, or emotional strain or tension”. Another popular definition of stress is, a condition or feeling experienced when a person perceives that demands exceed the personal and social resources the individual is able to mobilize (Selye 1976).

  Theories that focus on the specific relationship between external demands (stressors) and bodily processes (stress) can be grouped in two different categories: approaches to ‘systemic stress’ based in physiology and psychobiology (among others, Selye 1976) and approaches to ‘psychological stress’ developed within the field of cognitive psychology (Lazarus 1966, 1991, Lazarus and Folkman 1984, McGrath 1982). In Lazarus (1991) theory of psychological stress, stress is regarded as a relational concept, i.e., it is not defined as a specific kind of external stimulation nor a specific pattern of physiological, behavioural, or subjective reactions. Instead, stress is viewed as a relationship (‘transaction’) between individuals and their environment. ‘Psychological stress refers to a relationship with the environment that the person appraises as significant for his or her wellbeing and in which the demands tax or exceed available coping resources’ (Lazarus and Folkman 1986, p. 63). This definition points to two processes as central mediators within the person–environment transaction: *cognitive appraisal* i.e., individuals’ evaluation of the significance of what is happening for their well-being and *coping*, i.e., individuals’ efforts in thought and action to manage specific demands (cf. Lazarus 1993).

  The recently offered conservation of resources (COR) theory (Hobfoll 1989, Hobfoll et al. 1996) assumes that stress occurs in any of three contexts: when people experience loss of resources, when resources are threatened, or when people invest their resources without subsequent gain. Four categories of resources are proposed: object resources (i.e., physical objects such as home, clothing, or access to transportation), condition resources (e.g., employment, personal relationships), personal resources (e.g., skills or self-efficacy), and energy resources (means that facilitate the attainment of other resources, for example, money, credit, or knowledge).

  Social stress can be broadly defined as a situation which threatens one's relationships, esteem, or sense of belonging within a dyad, group, or larger social context.It can be more broadly construed, representing perceptions of one’s lower role or standing within a group or community (Juth and Dickerson, 2013).

- **Examples/Indicators:** The economic uncertainty caused by the job loss due to the closure of coal-mines and other related activities can create a huge psychological stress for the affected people.

Losing employment is one of life's most stressful experiences. Aside from the obvious financial anguish it can cause, the stress of losing a job can also take a heavy toll on your mood, relationships, and overall mental and emotional health.

- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes, previous studies have found that

  - women whose relatives and friends experienced stressful life events such as burglaries and illnesses found these events stressful to themselves, and reflected this vicarious stress in their own poor health (Eckenrode and Gore, 1981)

  - Sensitivity to the undesirable life events of others actually accounts for women's greater vulnerability to stressful life events in comparison to men (Kessler and McLeod, 1984).

  - men are distressed by events that happen to their children and spouses, women are distressed not only by these events but by events which occur to other members of the social network (Almeida & Kessler 1998)

  - women mobilize more social supports in times of stress than do men while relying less heavily than men on the spouse as a source of social support (Belle, Deborah 1988).

  - women maintain more emotionally intimate relationships than do men and provide more frequent and more effective social support to others than do men (Belle, Deborah 1988).
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group.
- **Internal relations (explained):** It is related to other factors, such as place attachment, resilience, social and cultural capital, social security system.
- **Possible overlap:** Socio-economic, Socio-political, Socio-cultural
- **Sources:** Lazarus R. S. (1966); Hobfoll S. E. (1989).
- **Other comments:**None

### *2.2.7.Perceived Fairness (Procedures and Distributive)*

- **Code:** C2-F07
- **Type:** Factor
- **Factor Description:** Perceptions of fairness refer to any element of the environment perceived by individuals or collectives as fair according to previous norms or standards (Peiró, et al. 2014). Fairness is a ubiquitous element, which is considered to be an important issue in different contexts (e.g., interpersonal relationships, organizations, consumer behaviour) (Ibid). Perceptions of fairness is associated with four elements: the rules and social norms governing how outcomes should be distributed (distributive justice), the procedures used for making such distribution decisions (procedural justice), how people are treated interpersonally (interpersonal justice), and how information is provided during the process (informational justice). The perceived distributive fairness depends on how people evaluate the balance between the costs that a certain group faces and the

benefits that it receives, in comparison to other groups (Adam 1965). It is particularly relevant in terms of energy transition in coal and carbon regions, since the distribution of costs and benefits of this transition will affect different groups (e.g. on the basis of spatial proximity) differently. If some groups (such as miners, industrialists) in the coal and carbon regions bear many costs and other groups (such as environmentalists and public servants) mainly receive the benefits and little direct costs, the perceived distributive fairness will remain low, which in turn will affect the acceptability of alternative energy sources and increases social unrest and psychological stress. Procedural fairness is related to decision making processes. The interactional fairness dimension is conceptualized as being composed of two facets, informational and interpersonal justice.

- **Examples/Indicators:** High perceived fairness

  - increases acceptability of collective decisions and support for collective pro-environmental projects (Terwel et al. 2010).

  - increases people's identification with an organization, motivating them to make an extra effort (Tyler & Degoey, 1995; Cropanzano and Folger 1996).

  - is positively associated with psychological well-being and decreases psychological distress (Fondocaro, Dunke, & Pathak, 1998).

  - increases social acceptability of alternative energy sources and decrease dissatisfaction among involved parties (Devine-Wright 2005; 2011; Moula et al. 2013).

  - reduces conflict regarding the use of alternative energy sources (Gross 2007).
- **Type of region:**Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Maybe, previous studies have highlighted that

  **-** men are more likely than women to distribute outcomes to individuals in direct proportion to their input (Kahn 1972).

  **-** the fairness-satisfaction relationship was not higher for men, and there were no practical differences in fairness perceptions and job satisfaction between men and women (Witt and Nye 1992).

  **-** satisfaction with an exchange relationship was more strongly related to perceptions of equity among men than women (Brockner and Adsit, 1986).

  **-** men and women differ in how they define distributive justice, with women placing more emphasis on their perceived standing and on their perceptions of the favourability of their outcomes (Kulik et al. 1996).
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** It is related to other factors, such as individual values, place identity, place dependence, social bonding.
- **Possible overlap:** Socio-economic, Socio-political, Socio-cultural
- **Sources:** Peiró, J. M., Martínez-Tur, V., & Moliner, C. (2014).

- **Other comments:** None.

### *2.2.8. Historical Nostalgia*

- **Code:** C2-F08
- **Type:** Factor
- **Factor Description:** The New Oxford Dictionary of English (1998) defines nostalgia as “a sentimental longing or wistful affection for the past”.Nostalgia is generally described as "a preference (general liking, positive attitude, or favourable affect) toward objects (people, places, or things) that were more common when one was younger (in early adulthood, in adolescence, in childhood, or even before birth)" (Holbrook and Schindler 1991: 330). Although previous studies have tested nostalgia in a unified form, recent research shows that nostalgia may be generated from either a personally remembered past (personal nostalgia: ‘the way I was’) or from a time in history before one was born (historical / communal nostalgia: ‘the way it was’) (Stern 1992; Baker and Kennedy 1994; Havlena and Holak 1991;1992; Hirsch 1992). Based on previous theory and research, each of these distinctly different responses are expected to follow differing cognitive paths as personal nostalgia makes use of the respondent’s autobiographical memories, also called personal or episodic memory, while historical nostalgia by definition does not do so. Instead it calls on collective memory (Halbwachs 1950; Meyers 2001) and employs a more ‘fantasy’ approach (Stern 1992).
- **Examples/Indicators:** Recent literature has shown that nostalgia can be seen as a stabilising force, as it can increase social connectedness and enhance positive self-regard. Nevertheless, nostalgia has also been associated to the desire to escape into the imagined, idealized world of a prior era. This emotion represents a different, and independent type of nostalgia, that is called historical nostalgia. Historical nostalgia is often associated with a deep dissatisfaction with the present and a preference for the way things were long ago.
- **Type of region:** Applicable in all regions.
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes,some of the first studies on nostalgia found that men were more nostalgic than women, due to the fact that they travelled more, and their lives entailed more changes (Davis, 1979).Nostalgia operated for men as a securing mechanism for their identities. An opposite view is presented by Holbrook (1993), who concluded that women are more prone to nostalgia. Other studies point out that there are no gender differences regarding anchoring processes in nostalgia (Sherman & Newman, 1978; Wildschut et al., 2006). On the other hand, Baker and Kennedy (1994) and Havlena and Holak (1991) indicated that men and women feel nostalgic about different things and each gender experiences nostalgia in a different way.
- **Primary Method:** Yes.
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** It is related to other factors, such as place attachment, resilience, perceived fairness.

- **Possible overlap:** Socio-economic, Socio-political, Socio-cultural
- **Sources:** Stern (1992).
- **Other comments:**None.

**Construct: General personal attitude and capacity**

### *2.2.9.Individual Resilience*

- **Code:** C2-F09
- **Type:** Factor
- **Factor Description:** Resilience refers to positive adaptation in the face of stress or trauma (Luthar, Cicchetti, & Becker, 2000). It is the ability to learn from the past, to be open and inclusive and to have a sense of purpose(Hegney et al. 2007). Studying resilience is important for achieving a comprehensive understanding of human responses to stress and trauma. Empirical evidence suggests that resilience is grounded in a diverse array of genetic (Caspi et al., 2003; Tannenbaum & Anisman, 2003), biological (Charney, 2004; Morgan et al., 2002), psychological (Campbell-Sills, Cohan, & Stein, 2006; Tugade & Fredrickson, 2004), and environmental (Haskett, Nears & Adams, 1998) factors. Since 2000, the notions of resilience and vulnerability have provided an important conceptual framework to understand how communities respond and adapt to environmental and societal changes (Adger 2006, Folke 2006). Resilience lies in the power of recovery and in the ability to return once again to those patterns of adaptations and competence that characterized the individual prior to the stress period (Garnezy, 1985). Chaskin (2008) argued that the community resilience should be seen as a positive adaptive response to adversity where resilient actors (individuals and/or networks) are able to drew on economic, social and environmental capital to adapt successfully and, thus are able to moderate or avoid negative consequences that similar threats visit upon less resilient individuals or networks. Resilience can be measured through Connor–Davidson Resilience Scale (CD-RISC; Connor & Davidson, 2003). The CDRISC is a self-report scale comprised of 25 items intended to measure resilience. A shorter version (with 10 items) of this scale has also been applied in many studies (Campbell-Sills & Stein 2007).
- **Examples/Indicators:**Resilience is a very important characteristic of the affected communities, which may affect their response to the phase-out of coal mines and transition towards alternative energy sources. The higher level of resilience....
  - moderate or avoid negative consequences of environmental and societal changes.
  - help people and communities to adapt with transition.
- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** May be.Some authors argue that current measures and conceptualizations of resilience are not gender sensitive. For instance, Hirani et al. point out that “women typically score lower on measures of resilience compared to men because existing conceptualizations of resilience

do not reflect the ways that gender roles, social expectations, perceptions and environmental factors interact to differentially shape women's and men's experiences and their responses to adversity". Other studies show that:

- Gender differences in resilience factors are guided by the notion that men and women have different personality trait that influence the way they cope with adversity. For instance, men tend to communicate less during the time of adversity and they end up getting less help and empathy as compared to women who communicate more and earn empathy and other types of support (Sun & Stewart, 2007).
- In terms of resilience, women and men are more similar than dissimilar (Morano 2010).

- **Primary Method:** Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** It is related to other factors, such as place identity, place rootedness, social bonding, place dependence,fairness, political regime, social and cultural capital, social security system, place quality, level of technological and economic development.
- **Possible overlap:** Socio-cultural, Socio-political, socio-economic, Socio-technical
- **Sources:**Campbell-Sills, Laura and Stein, Murray B. (2007).
- **Other comments:** Resilience is also associated with several sub-factors, such as trust, self-efficacy, motivation, knowledge, environmental identity, fair procedures etc.

### *2.2.10. Optimism*

- **Code:** C2-F10
- **Type:** Factor
- **Factor Description:** Optimism is a generalised tendency to expect positive outcomes or the belief that "good rather than bad things will happen in a person's life" (Scheier & Carver, 1993, p. 26). The term 'optimism' embraces two closely correlated concepts: the first is the inclination to hope, while the second more generally refers to the tendency to believe that we live in "the best of all possible worlds" (Conversano, et al. 2010). Optimism reflects the belief that the outcomes of events or experiences will generally be positive. Optimists are likely to see the causes of failure or negative experiences as temporary rather than permanent, specific rather than global, and external rather than internal. Such a perspective enables optimists to more easily see the possibility of change.Over the last few years, a significant body of research has been carried out about the effectiveness of optimism as a psychological phenomenon, leading to various theoretical formulations of the same concept, understood as "disposition", "attributional style", "cognitive bias", or "shared illusion"(Conversano, et al. 2010).Dispositional optimism is a trait of an equilibrated personality, in time and in various situations, that influences the way in which individuals come to terms with present, past and future events in life.Optimism, as an "attributional style", characterized by the tendency to believe that negative events are inconstant (the negative event will not repeat itself), external (I am not responsible for the event) and specific (the event is "specific", self-limiting and will

not influence any other activities of mine and my life). Referring to the viewpoint of *Social Cognition*, a third perspective sustains that optimism is the consequence of a cognitive underestimation of risk, in other words, a "bias" for the Self. This bias reflects the optimist's conviction that positive events are more likely to occur to him/herself while negative events prevalently affect others. Weinstein (1980) defined this phenomenon "unrealistic optimism".

- **Examples/Indicators:** Recent studies have found…

  - optimism facilitates adaptive behaviours and cognitive responses that consent negative information to be elaborated more efficiently and that are associated with greater flexibility and problem-solving capacity (Aspinwall et al. 2001).

  -positive and negative expectations regarding the future are important for understanding the vulnerability to natural and anthropogenic shocks.

  - optimistic individuals are positive about events in daily life.Positive correlations have been found between optimism and physical/mental well-being (Scheier and Carver, 1985)

  - optimists believe that positive events are more stable and frequent than negative ones. They think that they can avoid problems in daily life and prevent them from happening, and therefore they cope with stressful situations more successfully than pessimists (Peterson and De Avila, 1995; Aspinwall et al. 2001).

  - an inverse correlation between optimism and depressive symptoms (Chang and Sanna, 2001).

  - optimism is associated with better quality of life in terms of emotional, functional and socio-familial well-being (Friedman et al. 2006).

  **-** a significant positive relation between optimism and different aspects of life, such as coping strategies focalized on the problem, looking for social support and emphasis of the positive aspects of the stressful situation (Scheier et al. 1986).

- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes, previous studies have found that:

  -men tend to be significantly more optimistic than women regarding a broad range of issues, including the economy and financial markets (Jacobsen, et al. 2014).

  - For males, optimism and self-esteem influenced career expectations, sequentially predicting career goals, career planning and career exploration, rather among females, optimism directly influence career goals, which subsequently predicted career planning and career exploration (Patton, et al. 2004).

  - men are more optimistic than women; however, men are also more prone to be wrong in their beliefs about the future economic situation (Bjuggren, et al. 2019).

- **Primary Method:** Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** It is related to other factors, such as social bonding, place dependence,fairness.

- **Possible overlap:** Socio-cultural, Socio-political, socio-economic, Socio-technical
- **Sources:** Aspinwall, L. G., Richter L. and Hoffman RR. (2001).
- **Other comments:** Optimism is also associated with several sub-factors, such as trust, self-efficacy, motivation, knowledge, environmental identity, fair procedures etc.

**Construct: Coping Strategies**

### *2.2.11. Recalcitrance to resistance*

- **Code:** C2-F11
- **Type:** Factor
- **Factor Description:**Recalcitrance to resistance indicates an active reaction to change, even though a confrontational and defensive one. This reaction is activated when personal or collective identities are threatened by the ongoing change. Recalcitrance or resistance to the transition can include different behaviours, e.g. faint grumbling, filling formal grievance, engaging in counterproductive behaviours to get attention and force changes, participating in protest groups or even in violent protests.Recalcitrance is characterized by the general dissatisfaction of a group and the unconventional and sometimes violent ways people tend to show it. One example is rioting or when a large group of people behaves in a violent and uncontrolled way.It includes civil disorders, acts of mass civil disobedience, and strikes. They differ in their legality and tactics (especially the use or avoidance of violence), but all are acts by groups of people that are intended to disrupt a community or organization. Social unrest has been attributed to a variety of social, political, economic, and environmental causes including racial and ethnic tensions, food scarcity and food price increases, economic shocks, climate change and rainfall shocks, and demographic changes (Braha 2012). Political unrest is defined as the sum of riots, general strikes and anti-government demonstrations that is as lawful or unlawful collective action aimed against the national political authority and not entailing any military violence (Passarelli & Tabellini, 2017).
- **Examples/Indicators:** The stress caused by the job loss due to the closure of mines can lead to social and political unrest.
- **Type of region:**Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes. Gender is an important issue within social movements. At the same time a study about Exit, voice, and loyalty under municipal decline in Japan (Shonohara, 2017) identified a significant lower frequency of voice activities among women.
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** Out Migration, Re-opening of Mines
- **Possible overlap:** Socio-economic, Socio-cultural, Socio-political**.**

- **Sources:** Braha, Dan (2012) and Passarelli, Francesco & Tabellini, Guido (2017).
- **Other comments:** None

#### *2.2.12. Awaiting (status quo).*

- **Code:** C2-F12
- **Type:** Factor
- **Factor Description:**Awaiting is a strategy in which the response to the decarbonisation-induced impacts is just (passively) waiting for the situation to improve. Differently from other strategies (C2-F11) and (C2-F13), the individuals adopting this strategy do not engage with changing the status quo, but rather assume that someone else will take care of the problem.
- **Examples/Indicators:** Recent studies have found that many people choose to wait and tries to maintain status quo in the regions under transition.
- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes. Gender dimensions of Hirschman's typologies (exit, voice and loyalty) have been analysed in several studies.
- **Primary Method:** Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** It is related to other factors, such as social bonding, place dependence,fairness.
- **Possible overlap:** Socio-cultural, Socio-political, socio-economic, Socio-technical
- **Sources:**Hirschman (1970).
- **Other comments:** None.

#### *2.2.13. Personal and collective reinvention*

- **Code:** C2-F13
- **Type:** Factor
- **Factor Description:**Reinvention is defined as "the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation (Rogers, 2003: 180). It refers to the changes made to an innovation that are different from original intentions or designs. Thus, one way to measure reinvention is to identify the number of elements in an implementation that are different from "core elements" of the innovation, features that are considered to be responsible for its effectiveness (Glick & Hays, 1991; Rice & Rogers, 1980; Rogers, 2003). For example, policy reinvention can be measured by the liberalization of existing provisions or addition of new provisions to existing laws (Glick & Hays, 1991). Others have measured reinvention as how much the adopted innovation departs from the mainstream version of the innovation as promoted by a change agent (Rogers 2003).

- **Examples/Indicators:** This strategy represents an active and constructive response to the challenges of decarbonisation. Rather than opposing to the ongoing change (see C2-F11), this strategy implies an attempt of the individual to positively adapt to the new situation (e.g. learning new skills) or to contribute to a collective reinvention (e.g. creating new occupational niches). The individuals adopting this strategy accept to change their identity for copying with the risks coming from the environment.
- **Type of region:**Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruña, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes.
- **Primary Method:**Yes.
- **Method(s):** Survey, Interviews, Focus group.
- **Internal relations (explained):** Optimism**,** Social bonding,Out Migration.
- **Possible overlap:**Socio-economic, Socio-cultural, Socio-political, Socio-technical.
- **Sources:** Glick, H.R. and Hays, S.P. (1991), Hirschman (1970).
- **Other comments:** None

### *2.2.14. Submission*

- **Code:** C2-F14
- **Type:** Factor
- **Factor Description:**Submission is a passive response that progressively erodes the relationship between the individual and the territory. For responding to the unsatisfactory situation provoked by the transition ongoing in coal and carbon territory, the "submitted" individuals start lessening efforts, giving less consideration to quality, detaching from the relationship.
- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes.
- **Primary Method:** Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** It is related to other factors, such as social bonding, place dependence,fairness.
- **Possible overlap:** Socio-cultural, Socio-political, socio-economic, Socio-technical
- **Sources:**Hirschman (1970).
- **Other comments:** Optimism etc.

### *2.2.15. Migration intention or plan*

- **Code:** C2-F15
- **Type:** Dynamic

- **Dynamic Description:** This factor refers to a coping strategy in which the dissatisfaction of the current situation leads the individuals living in the coal and carbon territory to withdrawing from their relation with the territory and "move" elsewhere. This factors may include both migration wish (e.g. discuss migration options with relatives) but also migration preparation (e.g. collects concrete information on where to migrate and how).
- **Examples/Indicators:** Job loss due to the phase-out of coal mines and other related industries can provoke out-migration of people from the coal regions. Bad economic conditions caused by the closure of mines often lead to outmigration, which usually results into a loss of human resources, spending power, and taxable capacity in the region (Müller et al. 2005).

  The closure of coal mines in Lusatia and Rhineland contributed to the out migration of people from these regions (Pao-Yu Oei, et al. 2020)
- **Type of region:**Applicable in all regions.
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes, previous studies have highlighted that
  - Migration and mobility are always gendered.
  - Men are more prone to internal migration than women.
  - Based on data from UK - mine closure leads to relative decrease in male-female population in the area - significant change in gender composition: there is a drop in the share of women in total population. Mine closure leads to increase in share of single, unmarried, individuals (Aragon et al. 2018)
  - Young women tend to leave home earlier than young men, in rural and urban places alike (Jones, 2004), and they are more likely to migrate away from rural communities for education (McLaugh-lin, Shoff & Demi, 2014) and “more female-friendly labour markets” (Johansson, 2016; Kloep et al, 2003; Leibert, 2016; Measham & Fleming, 2014; Rauhut & Littke, 2016).
  - Persistent “occupational segregation” in rural communities, where young men tend to work in volatile but full-time, traditional industries, while young rural women work in service and retail, which tends to be less volatile but is rarely full-time, leading to women feeling “a greater ‘push’ (or ‘pull’) to the city than young rural men,” because the sectors where women tend to work often “[require] a higher standard of education,” and post-secondary programs tend to be found outside rural communities (Jones, 2004). Evidence suggests that a concentration of men—particularly if they are underemployed, unemployed and/or experiencing poverty—creates the conditions for a plethora of social problems from alcohol abuse to political extremism and hate groups (Leibert, 2016).
  - Importance of rethinking rural development policies as they have not been able to halt the exodus of women (Hoggart, 2004). East Germany: structural conditions, especially the situation on the labor market are important determinants of unbalanced sex ratios and sex-selective migration (Leibert, 2016)

- Care responsibilities lead to lesser special flexibility – it resists capitalist calls for flexibility and mobility. For example, fathers as breadwinners are more likely to migrate because of job opportunities, whereas mothers as caretakers tend to stay in one location because children should not move because of social bonding and changing a school is considered to be bad for children.
- Gendered patterns of out-migration from East- to West Germany have been observed. Evidence shows that young women have left East Germany more frequently than men and it is mainly related to labour market issues (Stauder, 2018).

- **Primary Method:**Yes.
- **Method(s):** Survey, Interviews, Focus group.
- **Internal relations (explained):** Socio-political unrest**.**
- **Possible overlap:** Socio-economic, Socio-cultural, Socio-political.
- **Sources:** Pao-Yu Oei, Hauke Hermann, Philipp Herpich, Oliver Holtemöller, Benjamin Lünenbürger, Christoph Schult, (2020),Hirschman (1970).
- **Other comments:** None

## 2.3. Patterns and Dynamics

### *2.3.1.Depopulation*

- **Code:** C2-P01
- **Type:** Pattern
- **Pattern Description:** Depopulation is a reduction in a human population size caused by short term events such as pandemics, wars, famines or other environmental catastrophes, or by long-term demographic trends, as in sub-replacement fertility rate, or persistent emigration. It is also caused by the human induced climate disasters and shifting of the economic activities from one region to another.

  'Depopulation' refers to a process in which the population density of an area decreases steadily over time. Increased human population is certainly a threat to environmental sustainability, but local phenomena of depopulation may be seen also as threats to local environmental sustainability (Jacob et al. 2008).Depopulation not only is a direct result of persistent out-migration but also reflects large second-order effects expressed in declining fertility and rising mortality -usually associated with population aging (Johnson and Lichter, 2019).

  The most widely accepted concept of depopulation refers to the process of chronic loss of population in a territory without any expectation of recovering or returning to the previous maximum population (Johnson & Lichter, 2019:4).
- **Examples/Indicators:** The out migration of people from the C&CI regions may accelerate the process of depopulation in these regions. The loss of job opportunities caused by the closure of coal based industries will compel the young people to move out of the region in search of work.
- **Type of region:**Applicable in all regions

- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** ~~No~~yes
  Closely related to out-migration, depopulation might significantly change gender composition, age and occupational structures in the region.
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** De-territorialisation, loss of territorial identity, slow-regional degradation.
- **Possible overlap:** Socio-economic, Socio-political, Socio-Ecological, Socio-Cultural.
- **Sources:** Johnson, Kenneth M. and Lichter, Daniel T. (2019).
- **Other comments:** None

### *2.3.2.Deterritorialisation*

- **Code:** C2-P02
- **Type:** Pattern
- **Pattern Description:** The term deterritorialisation is coined by Deleuze and Guattari (1972) in their philosophical project Capitalism and Schizophrenia. It refers to the problematic of territory losing its significance and power in everyday life (Tuathail, 2000). Deterritorialisation has been used as an anthropological concept to designate the weakened ties between culture and place: Certain cultural/social processes and relations seem to increasingly transcend their previously given territorial boundaries in flexible capitalist societies.
- **Examples/Indicators:** The out-migration of people from coal and carbon intensive regions may accelerate the process of de-territorialisation.
- **Type of region:**Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** yes
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** Loss of Territorial Identity, Slow-regional degradation, Re-territorialisation.
- **Possible overlap:** Socio-political, Socio-cultural
- **Sources:** Deleuze, Gilles and Guattari, Félix (1972).
- **Other comments:** None

### *2.3.3.Loss of Territorial Identity*

- **Code:** C2-P03
- **Type:** Pattern

- **Pattern Description:** Territorial identity emerges when 'a group of people accepts a fundamental similarity that causes them to feel solidarity among themselves', such as when feelings of similarity among people lead to solidarity (Figlestein et al., 2012, p. 108).
- **Examples/Indicators:** The closure of coal mines and coal related industries may lead to the loss of territorial identity of these regions. Coal miners' communities use their coal mines as a fundamental feature of their identity, that unites them.
- **Type of region:**Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** yes
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):**Deterritorialisation.
- **Possible overlap:** Socio-political, Socio-cultural
- **Sources:** Figlestein, N., Polyakova, A. and Sandholtz, W. (2012).
- **Other comments:** None

### *2.3.4. Slow-regional degradation*

- **Code:** C2-P04
- **Type:** Pattern
- **Pattern Description:** Slow regional degradation refers to the gradual erosion of economic, social, cultural and political institutions in the coal and carbon-intensive regions due to the closure of mines and related economic activities. It results from the submission, when people decide to accept the transition as it is and do not try to learn new skills (re-invent themselves) and look for other occupational niches in their local environment. In nearly all known cases, the end of mineral exploitation caused a number of serious problems, the "unavoidable socio-economic drama of pit closure" (Baeten et al. 1999, 250).

  **Examples/Indicators:** The decline of mining plunges the entire economic foundations of a region into crisis. It often proves difficult to attract new industry and business, and alternatives such as tourism are usually unable to produce as much prosperity as mining. This leads to a third set of problems: high unemployment with all the associated social impacts (Wirth, et al. 2012).

  Wirth, Peter, Černič Mali, Barbara, and Fischer, Wolfgang (2012) Problems and Potentials of Post-Mining Regions. In Wirth, Peter, Černič Mali, Barbara, and Fischer, Wolfgang (eds.) Post-Mining Regions in Central Europe Problems, Potentials, Possibilities pp. 14-31. Oekom: München.

  Lack of economic activities and new initiatives may push people towards social security systems for their survival. It will increase the economic burden on the social security system and lower the standard of living of people in these regions. After a generation of people living on social security, young people will have no choice but to emigrate from the region in search of employment opportunities.

- **Type of region:**Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** yes
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** De-population**,** Loss of Territorial Identity, Slow-regional degradation, Re-territorialisation.
- **Possible overlap:** Socio-political, Socio-cultural, Socio-economic
- **Sources:**Wirth, Peter, Černič Mali, Barbara, and Fischer, Wolfgang (2012)
- **Other comments:** None

### *2.3.5.Rise of Populism*

- **Code:** C2-P05
- **Type:** Pattern
- **Pattern Description:** Populism refers to a range of political stances that emphasise the idea of "the people" and often juxtapose this group against "the elite". Right-wing populism, also called national populism and right-wing nationalism, is a political ideology which combines right-wing politics and populist rhetoric and themes. The rhetoric often consists of anti-elitist sentiments, opposition to the Establishment, and speaking to the "common people".
- **Examples/Indicators:** In Poland, the right-wing populist media linked to the government rejects decarbonisation, ridicules climate change, and attacks environmentalists as the “agents”” of Western interests interfering in national interests (Zuk and Szulecki, 2020), also attacking women’s and LGBT rights as a threat to ‘national tradition’ and the “traditional family” for ideological and cultural reasons (Zuk and Zuk 2020).
- **Type of region:**Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Maybe, few studies have shown that
  - women can be agents of social change on national and local levels, a factor that strengthens civic activities and local democracy (Gittell et. al. 2000)
  - Policies of populist governments might affect women and men differently.

  Previous studies have shown consistent gender trends in electoral behaviour: women are more likely to support left-wing candidates and men are more likely to support right-wing candidates (Ingelhart & Norris, 2000)
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** Loss of Territorial Identity, Slow-regional degradation, Re-territorialisation.

- **Possible overlap:** Socio-political, Socio-cultural, Socio-economic
- **Sources:** Zuk, Piotr and Paczesniak Anna (2020).
- **Other comments:** None

### *2.3.6. Re-territorialisation*

- **Code:** C2-D1
- **Type:** Dynamic
- **Pattern Description:** Reterritorialization is the restructuring of a place or territory that has experienced Deterritorialisation. It isthe process of establishing new social linkages between a human community and its territory, that normally happens when a relative de-territorialisation process is ongoing. Reterritorialization refers to the reconfiguration and re-scaling of forms of territorial organisation such as cities and states (Brenner, 1999).
- **Examples/Indicators:** The deterritorialisation caused by this ongoing energy transition in different C&CI regions can be countered by accelerating the re-territorialisation process
- **Type of region:**Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Maybe…
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** De-population, De-territorialisation,Loss of Territorial Identity.
- **Possible overlap:** Socio-political, Socio-cultural, Socio-economic, Socio-ecological.
- **Sources:** Brenner, N. (1999).
- **Other comments:** None

### *2.3.7. Environmental degradation*

- **Code:** C2-D2
- **Type:** Dynamic
- **Pattern Description:** Environmental degradation is a process through which the natural environment is compromised in some way, reducing biological diversity and the general health of the environment. This process can be entirely natural in origin, or it can be accelerated or caused by human activities. Many international organizations recognize environmental degradation as one of the major threats facing the planet, since humans have only been given one Earth to work with, and if the environment becomes irreparably compromised, it could mean the end of human existence.
- **Examples/Indicators:** Mining has almost everywhere caused considerable environmental degradation. This encompasses abandoned surface mines, underground galleries, lowered ground water levels, and contaminated sites in mining and related industries such as energy, iron and steel, and chemicals. Affected cities are usually burdened by disused mining facilities, miners' settlements, and often over dimensioned and dilapidated infrastructures (Wirth, et al. 2012).

Opening of new coal-mines or continuous excavation and burning of coal and other high carbon energy sources may accelerate the global warming and climate change, which will have dire consequences for our environment.

- **Type of region:**Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, South Wales.
- **Gender-sensitive:** Yes, women are slightly more likely than men to be concerned about the environment and have stronger pro-climate opinions and beliefs (Mohai, 1997).
- **Primary Method:**Yes
- **Method(s):** Survey, Interviews, Focus group
- **Internal relations (explained):** Slow regional degradation.
- **Possible overlap:** Socio-ecological, Socio-economic.
- **Sources:**Wirth, Peter, Černič Mali, Barbara, and Fischer, Wolfgang (2012)
- **Other comments:** None.

# 3. Literature overview

## 3.1. Overview

In the socio-psychological component, we have reviewed the papers published in different fields of research including psychology, environmental psychology, social psychology, geography, gender studies and related disciplines.

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# ANNEX 3

## Socio-political Component

Short Report on Key Factors, Dynamics and Patterns

# DocumentControlSheet

| Project Title | |
|---|---|
| **Work package** | **WP1** |
| **Task** | **1.5 Socio-political key factors, dynamics and patterns** |
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## Table of Contents

# 1. The Socio-Political Component

## 1.1. Introduction

Politics in its broaden definition (from Greek: Πολιτικά, politiká, 'affairs of the cities') is the set of activities that are associated with making decisions in groups, or other forms of power relations between individuals, such as the distribution of resources or status. The politics in this sense is firmly embedded into the local, national or international context.

The social and political context shapes norms and values, which in turn influence the meaning given to technological change it selves (MacKenzie and Wajcman 1985). If we approach politics as the way how people are living and/or participating in different groups making decisions, the decarbonisation process represents signifficant challenge to the state of the affairs, since it is affecting not only macvroeconomy of a region, but challenge positions of different actors, influence well-being of different people in a different way and, last tbut not least, accelerate many other processes and conflicts (e.g., shift to industry 4.0., demographic change).

Decarbonization processes at a regional level encompass often complicated shifts in local power, social positions and economic benefits. Together with influence of outside factors, a region facing transformation represent complicated field in Bourdieu theoretical framework, where access to the benefits of decarbonization/transformation, or exclusion from the access to the benefits generated different politcal narratives and positions on the transformation. Interests, positions and motivations of constituencies or stakeholders in the field inevitably differ. The outcome is situation, where different constituencies are strengthening and propelling changes, or sometimes hindering and slowing down decarbonization. Using theoretical approach of Pierre Bourdieu and relying on concept of technological drama we analyse situation in the project case studies.

Based on the empirical research we will categorise main stakeholders groups and define and analyse constituencies in the decarbonation processes. In accord with technological drama framework we opetare here with the design constituencies (those who impose the changes) and impact constituencies (those who either cope or resist).The aim is to explore the ongoing and emerging social and political conflicts in the "local field of power" (Bourdieu: The Social structures of Economy, Polity Press, 2020).

Theoretical point of departure is Bourdieu's notion of the field of local powers (2005), which is territorially based and hierarchically structured social space, where the greatest structural weight invariably lies with those holding political and administrative power. Within this field a long series of interactions and confrontations take place between social actors, who as a function of their position in objective structures of power, pursue diverse strategies.

Within this field different actors exposed to the technological change, pursuing three possible strategies: imposing, coping and resisting. In Pfaffenberger (1992) perspective it is technological regularization, adjustment and reconstitution. The crucial aspect in the field are capital accumulation processes, which means continuous application of new technologies designed with consequences such as fragmentation and de-skill of labour force so that labour becomes cheaper and subject to greater political and social control. The decarboniosation is undestood here as a technological change generating political conflics leading to variuous decisions.

### 1.2. Component key feature

The socio-political component will focus ion the following areas of inquiry:

- Applying Bourdies theory of field as the framework of our analysisto improve understandingof the subject matter, where interests of various actors and stakeholder intertwine, interact mutually and are in conflict - The “field of power”.
- The inertia of technological systems, the existence of trends has an internal logic in technological developments, and in the historical transformations associated with key technological innovation (Alan Dafoe, 2015). Using theories of technological changes/innovationwill help to address underexplored areas of inquiry which include the study of the political effects of decarbonisation.
- Applying the concept of technological drama - technological regularization, technological adjustment and technological reconstitution (Brian Pfaffenberger 1992) will frame approach to study impacts of the phase-out of coalmines and closure of carbon intensive industrial companies on political narratives. Using a grid ofImposing, Coping and Resisting Constituencies each case study describes and analyze their policy narratives and policy strategies vis-à-vis decarbonization in the territory.

The main sests of research questions are:

- How do the different identified stakeholdersform constituencies and how it is reflected in the local field of power? Who and how shapes/controls political conflicts, strategies and outcomes in the decarbonisation processes?
- How do design constituencies (those who impose the changes) and impact constituencies (those who either cope or resist) understand benefits and losses from the decarbonization process and operationalize them? How do they develop their narratives of decarbonisation at the regional/national level?
- How is the politics of decarbonization influenced by the constituencies and their narratives?

### 1.3. Component synthetic description

- **Component lead partner:**Center for Social and Psychological Sciences (CSPS)
- **Other partners:** K&I
- **Overall approach:**Qualitative sociological research
- **Domain of enquiry:** Constituencies forming policy narrativesand shaping policies of decarbonisation related to the territorial change. The focus will be on:
    - Socio-Political narratives forming political discourse directly or indirectly related to the coal and carbon phase out in thirteen different regions in the EU; identification of drivers/barriers resulting from these narratives in the local field of power.
- **Theory:**
    - Local field of power (Bourdieu, 1980)
    - Technology drama (Pfaffenberger 1992)
    - The Social Shaping of Technology (MacKenzie and Wajcman 1985).
- **Primary method:** Textanalyses
- **Secondary method:** In-depth interviews
- **Case diversification:** There will be rather substantial diversification - mainly due to historical, administrative and contextual factors in different regions and in selected case studies. Although this component builds on the same research items (factors, dynamics, and patterns), stakeholder groups and constituencies will vary, as well as the local fields of power. In addition we may face some modifications based on different countries' administrative systems shaping regional/national politics and, last but not least, the countries are in very different stage of decarbonisation (e.g., early steps, or in the middle of the processes versus post-decarbonisation stages). Nature of the political components is therefore depending on the individual countries' conditions. Thus, despite the unified research set, some specific research items, can be applied in cases with certain ideosyncratic features.
- **Research area definition:** Socio-political component explores the ongoing and emerging social and political conflicts in the "local field of power" (Bourdieu: The Social structures of Economy, Polity Press, 2020), which pertains the decarbonation processes by analysing design constituencies (those who impose the changes) and impact constituencies (those who either coping or resist) and providing data and information on how local/regional social and political factors influence decarbonisation. Coal and carbon intensive regions or 'de-carbonisation' regions are each unique in its historical and socio-economic context. Very imporant aspect is presence, shape and size of vulnerable communities (e.g., migrant workers, immigrants, ethnic minorities), distribution of positive and adverse effectsand how these impact constituencies influence social and political dynamics.In the defined regions we therefore further focus on the most vulnerable social groups and their narratives and changing political preferencies, their political and social position in the local field of power. Since the most vulnerable groups are often diffult to reach, we will rely on analyses and materials published by researchers and other stakeholders (e.g. social NGOs) and their presentation

in the public discourse. Last but not least, gender plays and important role in decarbonisation processes, shaping directly or indirectly local political narratives and processes.

# 2. Factors, Dynamics and Patterns

## 2.1. Overview

For this study, we have identified sixfactors that may influence decarbonisation in its socio-political context.

**(Figure 1). All factors discussed below:**

| FACTORS |
|---|
| **Exclusion: form access to benefits of decarbonisation** |
| **Uneven Incorporation: lack of space for the carbon industries** |
| **Polarisation: stigmatization vs. idea of progress** |
| **Segregation: "de-facto" barriers to access decarbonization advantages** |
| **Centralisation: higher regional dependence on the center** |
| **Countersignification: claim for a just transition** |
| **Counterdelegation: negotiating clean coal technology** |
| **Antisignification: rejecting and denial of decarbonization** |

## 2.2. Factors

### *2.2.1. Exclusion: form access to benefits of decarbonisation*

Code: C3-F01

- **Type:** Factor
- **Factor Description:**

Coal mining and carbon intensive industries have been traditionally heavily dependent on large organized workforce often lower-skilled workers. On the one hand, harsh working conditions, pollution, three-shift operations and health risksmade these working position unattractive. On the other hand, this type of industry provided job opportunities for otherwise marginalized ethnic minorities (such as Roma/Gypsies) and migrants who were otherwise disadvantaged on the labor market.

Decline of the mining industry and/or traditional large and carbon intensive enterprises is thus related with jobs losses especially for ethnic minorities and migrants. These people are usually hired on the

principle “last in - the first out”. Resulting unemployment may have strong ethnic connotations and is then presented in the public discourse as a result of individual failures (blaming the poor) combining with increasing populism blaming the minorities for local problems.

- **Examples/Indicators:**

  Mines in Upper Nitra, Slovakia attracted intra-state migration of Roma ethnic minority population into the region. They formed “miners’ colony” in Handlová where many of them live, the mine and affiliated companies provided them with steady jobs. The labor intensive industry such as mining, was also supposed to be an integration vehicle for the poverty-stricken and backward Roma/Gypsies. Many Romani workers gradually overcme the barriers of segregation and got apartments in towns in Handlová and Prievidza. These apartments were provided by the mining company and led to socail integration of the Roma. After the political changes in the 1990s neoliberal restructuralisation of the economy and gradual downsizing in the mining industry, Roma were among the first who lost their jobs. Many of them were consequently evicted from houses located centrally in the town and formed new urban ghetto on the outskirts in Prievidza. Town of Partizanske forced eviction of the people from their apartments too. These policies were supported by the majority population and local politicians use anti-Roma populism as a toll to attract votes.
- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes. While the perspective on phasing-out carbon intensive industries (Fine 1990) is formulated in gender-neutral terms,there are diverseimpacts on men and women.This relates to different roles and norms in the economic, political and social system. While mainly men are employed in the coal and carbon-intensive industries, resource shocks, specific to men, can create negative spill-overs to female workers in the rest of the economy (Aragon et al. 2018). Understanding gender-specific effects in the labour market is important given the evidence linking women's relative labour opportunities to a host of other outcomes such as their political influence and intra-household bargaining power (Aizer, 2010). While the reduction of the gender pay gaps during negative resource shocks may be seen as a positive trend towards gender equality, the reduction is merely due to reduced average wages (Bennett, 2004; Bennett et al., 2020). In fact, Bennett et al. (2020) find that the overall females’ relative share of household earnings declines by 6% after a negative resource shock. Furthermore, when other jobs are available, care-givers (often women) have to become involved in both reproductive and productive work to substitute lost income from mine closures. While Shermann (2009) shows that this is an opportunity for changing gender perspectives and roles towards higher independence and self-esteem of women, other studies (Aung & Strambo, 2020; Bennett 2004; Elias, 2011; Oberhauser and Turnage, 1999) find that additional work might not always be voluntarily and create an additional burden if there are no public and affordable care structures in place. The consequences of the pandemic in 2020 have shown that care-givers (who are mainly female) are the backbone of our economy. For the wellbeing of the region, care structures need to be in place and most affected groups of people, i.e. migration

workers, women, elderly, need to receive necessary skills to join alternative industries or become entrepreneurs. Diverse perspectives needto be included in economic and political decisions.

- **Primary Method:** Yes
- **Method(s): Text research,** Interviews,
- **Internal relations with other factors:** It is related to some individual and institutional (such as distributive justice, political regimes, social and cultural capital, social security system, level of technological and economic development etc.) factors.
- **Possible overlap with other Components:** Socio-cultural, Socio-political, Socio-economic.
- **Sources:.**

Fine, B. 1990. Political Economy and Industrial Change from the Nineteenth Century to the Present Day. New York: Routledge, Chapman & Hall.

Filcak, R. and Jeck, T. 2020. The Potential and Challenges of Socially Sensitive, Low-Carbon Regional Transition: the Case of Small and Medium Enterprises in Upper Nitra. Bratislava: Centre of Social and Psychological Sciences, 110 p. ISBN 978-80-89524-44-0(APVV-17-0141

Horváth, G., and Csüllög, G. (2012). Salgótarján (Hungary) – The Rise and Fall of a Mining and Industrial Region. In *Post-Mining Regions in Central Europe. Problems, Potentials, Possibilities*. Edited by Peter Wirth, Barbara Černič Mali and Wolfgang Fischer, 40–52. Munich: Oekom. Available at: https://www.ioer.de/fileadmin/internet/IOER_Projekte/PDF/FB_L/ Book_Publication_Post-Mining_Regions_in_Central_Europe.pdf.

Ralf Bosen, 2018. Coal mining as a melting pot: Everyone's the same underground. https://www.dw.com/en/coal-mining-as-a-melting-pot-everyones-the-same-underground/a-46778235

Coderre-Proulx, M., Campbell, B. and Mandé, I. 2016. International Migrant Workers in the Mining Sector. Geneva: ILO. https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---migrant/documents/publication/wcms_538488.pdf

- **Other comments:** Place attachment is also associated with several sub-factors, such as individual values, trust, self-efficacy, motivation, knowledge, environmental identity, place identification, sense of belonging, place memory, place familiarity, place expectation, etc., which shows different aspects of people's relationship with their territory.

### *2.2.2. Uneven incorporation: lack of space for the carbon industries*

Code: C3-F02

- **Type:** Factor
- **Factor Description:**

Uneven incorporation in the decarbonization process is structured in a way that some groups are set aside and some are incorporated into it. The economic power of the carbon intensive industries declines,

they are not able to generate jobs and prosperity and their position as key stakeholders and ruling class in local politics is gradually weakening on the account of strengthening position of other economic sectors and other stakeholders. The coal and carbon-based industries were economic backbones of the regions, providing besides jobs also extensive social services (health care for the employees, schools, recreational facilities). They have served as pillars of the local economy and were key partner in political negotiations and governance. Former executives, or local political represntatives supported by the companies were regularly winning local elections.

Declining of the carbon industry is reflected in falling support to the industry backed political alliancies and leaders in regional/local politics and increase of the new establishement affiliated with new businesses and services. Some of the carbon industries are trying to keep their influence through diversifying their economic activities and investing into new areas of businesses.

- **Examples/Indicators:**

The economy of the Upper Nitra (Slovak rep.) diversified in the 2000s with activities in the automotive sector, machinery, manufacturing of plastics, and production of safety and control technologies. The HBP coal mine and its daughter HBz are still among the largest employers in the region, but their productivity (in terms of revenue per employee) declined by 19% in the period 2010-2017. Other major employers, however, significantly expanded their revenues in the region during the same period. The mining company invests into food processing, and manufacturing to stay on the market.

The mining company used to dominate local politics for decades. In the last years it is however facing increasing political opposition. Mayors of the key districts, former mine employees or people supported by the industry, has been gradually replaced by parties and politicians confronting role of the carbon industries in a longer term development perspectives.

- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.

**Gender-sensitive:** Yes. The impact is rather context-specific. Women are generally underrepresented in unions due to several constraints. For instance, in the UK some unions restricted part-time workers to enter the union which simultaneously excluded many women since a high share of women are part-time employed in the UK (Ledwith, 2009, p.91). Furthermore, even if women take part in unions, Stroud and Fairbrother (2009) show that women in Poland still tend to face the glass ceiling and they are poorly represented in higher levels of union structures. Yet, in Lower Silesia, 70% of all union founders were female in the years 2006-2007. The limited representation of women in unions is also linked to their low political involvement as well as to lacking gender-related policies and measures.Women are, however, leading global climate movements and increasingly raise their voice(UBA, 2020).New industry establishments related to clean energy and environmentally friendly behaviour, in which women are more represented than in the fossil fuel industry,maycontribute to this trend (Clancy & Feenstra, 2019).

- **Primary Method:** Yes

- **Method(s): Text research,** Interviews
- **Internal relations with other factors:** It is related to some individual and institutional (such as distributive justice, political regimes, social and cultural capital, social security system, level of technological and economic development etc.) factors.
- **Possible overlap with other Components:** Socio-cultural, Socio-political, Socio-economic.
- **Sources:** .

Pfaffenberger, B. 1992. Technological Dramas, Science, Technology, & Human Values, Vol. 17, No. 3 (Summer, 1992), pp. 282-312.

Dafoe, A. 2015. On Technological Determinism: A Typology, Scope Conditions, and a Mechanism. Science, Technology, & Human Values , November 2015, Vol. 40, No. 6 (November 2015), pp. 1047-1076

Bourdieu, P. 2005. The Social Structures of Economy. Polity Press.

Wirth,P., Černič Mali, B. and Fischer. W. 2012. Post-Mining Regions in Central Europe. Problems, Potentials, Possibilities. Munich: Oekom. Available at: https://www.ioer.de/fileadmin/internet/IOER_Projekte/PDF/FB_L/ Book_Publication_Post-Mining_Regions_in_Central_Europe.pdf.

**Other comments:** Place attachment is also associated with several sub-factors, such as individual values, trust, self-efficacy, motivation, knowledge, environmental identity, place identification, sense of belonging, place memory, place familiarity, place expectation, etc., which shows different aspects of people's relationship with their territory.

### *2.2.3. Polarisation: stigmatization vs. idea of progress*

Code: C3-F03

- **Type:** Factor
- **Factor Description:**

In technological regularization, a design constituency creates, appropriates, and modifies a technological artifact, activity, or the system. It is projected into a spatially defined, discursively regulated social context, which is crucial to actualizing the technology's constructed social - political aims. (Pfaffenberger 1992). Decarbonisation in this perspective is imposed by the design constituency as a dichotomy between "progress" and "backwardness". In other words, supporters of the "old" industries are stigmatised in the public discourse, leading to the discourse polarisation. The demographic change, perception of the fossil industry (as lacking la ong term perspectives) and shift in coping strategies of youngergenerations further reinforce these dynamics.

- **Examples/Indicators:**

Coal miming regions used to be a stronghold for leftists/social democratic parties, strongly supporting the mining industry. In the last decade this supports fade out and voters are more prone to vote different political representatives, including those strongly opposing the mining and carbon intensive industries.

- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes.Bourdieu's Habitus refers to "systems of durable, transposable dispositions, structured structures predisposed to function as structuring structures, that is, as principles which generate and organize practices and representation" (Bourdieu, 1990: p.53). According to King (2000), the habitus depends on the socioeconomic or structural position of the individual. That means that "individuals unconsciously internalize their objective social conditions, such as their economic class, so that they have the appropriate tastes and perform the appropriate practices for that social position" (King, 2000: p. 423). Thus, individual's choices, thoughts and feelings are shaped by social structures, by how their social group categorizes and perceives reality. Nevertheless, the habitus is not constant: different conditions result in different social practices. Although Bourdieu gives more relevance to the classed-habitus, it is also possible to talk about a gendered habitus. Understanding gender as an ongoing practice rather than static and biologic differences between women and men, the gendered habitus is related to the actual, situated practices and ways of "doing" both masculinity and femininity (Miller, 2016). Current polarization regarding decarbonization might be understood as a clash between gendered habitus.The mining industry and former coal mining supporters and stakeholders, such as workers, trade unions and politicians are strongly associated with a certain male "habitus", characterized by toughness, physical strength, and control. But, an increasing awareness about gender and diversity has rendered the discourse of traditional masculinity backward-looking.Supporters of decarbonization and environmental movements on the other hand (e.g. Fridays for Future) have a younger and female image, which is considered progressive, also because they are perceived as performing new forms of femininity and masculinity, progressive, gender-inclusive and diverse. Gender patterns are interwoven into the carbon coal discourse, playing a role on an implicit, subtle level. Ignoring such patterns might exacerbate the conflict.

- **Primary Method:** Yes
- **Method(s): Text research,** Interviews
- **Internal relations with other factors:** It is related to some individual and institutional (such as distributive justice, political regimes, social and cultural capital, social security system, level of technological and economic development etc.) factors.
- **Possible overlap with other Components:** Socio-cultural, Socio-political, Socio-economic.
- **Sources:** .

Pfaffenberger, B. 1992. Technological Dramas, Science, Technology, & Human Values, Vol. 17, No. 3 (Summer, 1992), pp. 282-312.

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### *2.2.4. Segregation: "de-facto" barriers to access decarbonization advantages*

Code: C3-F04

- **Type:** Factor
- **Factor Description:**

Decarbonisation is usually followed up by the rise in IT technologies, automation, and advanced technologies in produsction and services, that are becoming at the gist of the economic development. However, some stakeholders are excluded in use of these technologies, given their place in the system of hierarchies. These groups can be low-income households (lack of accest to PCs or internet connection, low education and skills), these can be small and medium enterprenuers (lack of capital to invest into computerisation of their bussineess), under-funded public institutions such as schools.

Governments may to a great extend control technologies supply and use, as well as form economic regulations and acccess to theopportunities. Access to the technologies and its benefits is in principle open to all, but the system is constructed so that users have little autonomy and significant decisions are reserved for central governments.

- **Examples/Indicators:**

Transformation of the regional economy to productions and services based on IT technologies. Segregation of the sectors (e.g., SMEs, public) in their access to technoogies and its benefits. Decreasing number of SMEs operating on the market.

- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:**This factor may be gender-sensitive in its impacts on the more vulnerable single parent families (e.g., public versus private schools). There may be differentiated impact on the female enterpreneuers in services (dominated by female emploees).
- **Primary Method:** Yes
- **Method(s):** Text research,Interviews
- **Internal relations with other factors:** It is related to some individual and institutional (such as distributive justice, political regimes, social and cultural capital, social security system, level of technological and economic development etc.) factors.
- **Possible overlap with other Components:** Socio-psychological, Socio-economic.
- **Sources:** .

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Rothwell, R. (1991). External networking and innovation in small and medium-sized manufacturing firms in Europe. In *Technovation*, 11 (2): 93-112.

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### *2.2.5. Centralisation: higher regional dependence on the center*

Code: C3-F05

- **Type:** Factor
- **Factor Description:**

The carbon intensive industries, mines, ironmills and others have been generating substantial income (partly because negative environmental externalities are not fully reflected in costs of their products). This in turn means very strong position in the local economy. Negotiating power of centralised fossil industries is comparatively higher when it comes to various forms of subsidies and regulations by the central government.

In the aftermath of the decarbonisationregions may become more dependent on the center than before. Decentralised local economy with its bases in small and medium enterprises requires diversified support.

Paradoxically, thus after the phasing out of heavy industries, regions are increasingly dependent in econonomic terms on central regulations and stimuli, e.g., governmental grants and compensations or fiscal insturments (e.g., tax bonuses).

- **Examples/Indicators:**

Increasing dependence of decarbonising regions on financial transfers from the central government influence performance evaluation of the local governments, which are primary evaluated as succcessful in terms of investments they manage (or not manage) to receive from the central budget.

- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** This factor may be gender-sensitive in its consequences, i.e. national gender equality strategies may have to be taken into account much more in order to be able to receive funds at local / regional level. The funds themselves should include gender budgeting so that the local government spends the same amount of money on measures that benefit male / female citizens.
- **Primary Method:** Yes
- **Method(s): Text research,** Interviews
- **Internal relations with other factors:** It is related to some individual and institutional (such as distributive justice, political regimes, social and cultural capital, social security system, level of technological and economic development etc.) factors.
- **Possible overlap with other Components:** Socio-cultural, Socio-political, Socio-economic.
- **Sources:** .

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### *2.2.6. Countersignification: claim for a just transition*

Code: C3-F06

- **Type:** Factor
- **Factor Description:**

In technological reconstitution, impact constituencies actively reshape perceptions of technological production processes, trying to resist changes, which are viewed as undermining their position and wellbeing (Pfaffenberger 1992, Wajcman 2000). Traditionally, the main opposition to decarbonization processes found among the employees of the mines and carbon intensive enterprises and its concern, that it brings laboring populations in to the lower-class sectors and spaces of relatively wealthy societies.

Traditional coal mining and carbon intensive industries are affiliated with smaller number of centralized and large firms. The socio-political changes affiliated with decarbonization are weakening bargaining power of the organized labor. Traditional trade unions used to be key policy player, influencing political decisions and having impact on the political decision making. In some countries trade unions are still strong factor in preserving the employment structure in the mining sector. For instance in Poland, where the level of unionisation reaches over 100 percent, a miner may belong to more than one trade union, compared to fifteen per cent in the whole economy (Szpor 2018) and where bargaining power of the unions is still significant. Nevertheless, in a mid and long-term perspective it is declining in most of the coal mining and carbon intensive regions.

- **Examples/Indicators:**

The miners' strike of 1984-85 in the UK as a major industrial action to shut down the British coal industry in an attempt to prevent colliery closures. The defeat significantly weakened the trade union movement and can be seen as blueprint followed by governments in other countries.

- **Type of region:** Applicable in all regions
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes. See input above.
- **Primary Method:** Yes
- **Method(s): Text research,** Interviews
- **Internal relations with other factors:** It is related to some individual and institutional (such as distributive justice, political regimes, social and cultural capital, social security system, level of technological and economic development etc.) factors.
- **Possible overlap with other Components:** Socio-cultural, Socio-political, Socio-economic.
- **Sources:** .

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  Beatty, C., Fothergill, S., and Powell, R. (2007). Twenty Years on: Has the Economy of the UK Coalfields Recovered? In Environment and Planning, 39(7): 1654–75.

  Socio-economic transformation in coal transition regions: Analysis and proposed approach - Pilot case in Upper Nitra, Slovakia (JRC, 2018)

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### *2.2.7. Counterdelegation: negotiating clean coal technology*

Code: C3-F07

### *2.2.8. Antisignification: rejecting and denial of decarbonization*

Code: C3-F08

- **Type:** Factor
- **Factor Description:**

The disawow may arise as a reaction on regularization, polarization and stigmatization in the public discourse on decarbonization. People whose status is invidiously affected by decarbonisation choose from a variety of potential responses. Beyond passivity, apathy, and resignation, they may attempt countersignification, in which they covertly substitute a myth or root paradigm that contradicts the mythos of transformation.

It may have a form of presenting decarbonization as a concept from the "outside" (e.g., imposed on us by the EU and/or detached elites or people with vested interests benefiting from RE). Decarbonization is in this narrative presented as irresponsible, costly and basically as a misleading process with vested interests. Disawow is an act of mythos substitution that decomposes and rehistoricizes the meanings embodied in decarbonisation and may embody inclination to conspiracy theories and support of populism in politics.

- **Examples/Indicators:**

Raise of pulism and nationalism in the affected regions, opposition to coal mine closure presented in the narratives of alternative parties as a threat to "national interests", developing dychotomy beween central governemnt policies and the regional policies.

- **Type of region:** Applicable in all regions, also intensity and signifficance may vary.
- **Regions:** Silesia, Lusatia, Rhineland, Central Germany, Jiu Valley, Sulcis, Upper Nitra, Brindisi, MA Krakow, A Coruna, Upper Styria, Stavanger, South Wales.
- **Gender-sensitive:** Yes.On average more women than men are aware of climate change, perceive it as a risk, behave more environmentally friendly and are engaged in climate-relatedvoluntary work andmovements(UBA, 2020). Furthermore, there is a gender gap in the votes for Populist Radical Right – on average more men advocate for centre-right / right / far-right(Spierings & Zaslove, 2017). This may be linked to the gendered habitus – the likelihood of men to be voting for more traditional values that might be perceived as backwards from a female or non-binary perspective.
- **Primary Method:** Yes
- **Method(s): Text research,** Interviews
- **Internal relations with other factors:** It is related to some individual and institutional (such as distributive justice, political regimes, social and cultural capital, social security system, level of technological and economic development etc.) factors.
- **Possible overlap with other Components:** Socio-cultural, Socio-political, Socio-economic.
- **Sources:** .

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# 3. Literature overview

## 3.1. Overview

In the socio-political component, we have reviewed the articles, books and papers published in the fields of theoretical sociological and politological research of society, inluding possible methodological papaches. In the second stream we reviewed articles, books and papers on social and political analyses of decarbonisation processes on the national or regional level.

### 3.2. Theoretical appaches to study politics of decarbonisatio

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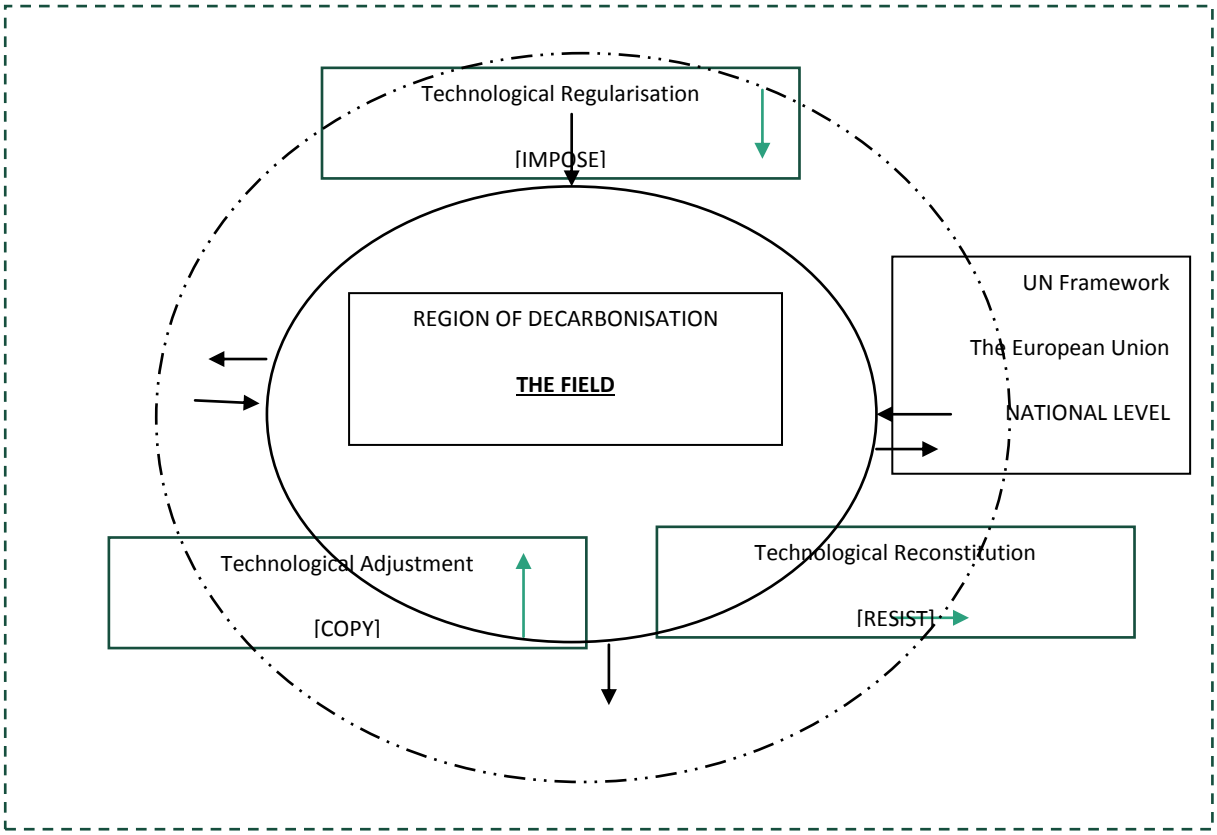
United Nations [UN] (2015) Paris Agreement. https://unfccc.int/sites/default/files/english_ paris_agreement.pdf Universities UK (2018) Solving Future Skills Challenges. https://www.universitiesuk.ac.uk/ policy-and-analysis/reports/Documents/2018/solving-future-skills-challenges.pdf

**Figure 1 – Socio-polical conflics and processe ("the field")**



# ANNEX 4

## Socio-Economic Component

Short Report on Key Factors, Dynamics and Patterns

# Document Control Sheet

| Project Title | ENTRANCES |
|---|---|
| **Work package** | **Conceptual framework** |
| **Task** | **T1.1** |
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| | |
|---|---|
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# 1. The Socio-EconomicComponent

## 1.1. Introduction

The European Unionaims to be climate neutraluntil 2050. An important step towards climate neutrality is the reduction of greenhouse gas emissions in the electricity sector. A coal phase-out and transformation of carbon-intensive industries is necessary under the current technological and political regime to achieve this. The economic role of coal and carbon-intensive industries varies across European regions. Coal and carbon-intensive regions face a more substantialstructural change than other regions, which rely less on coal or carbon-intensive industries.

In previous structural change, like the industrial revolution, the transformation from a secondary-industry economy to a tertiary-industry economy or the ongoing digitisation have multiple consequences for regions and industries. For instance, the industrial revolution led to increased use of coal as an energy source, but also a tremendous structural change of the economy. Workers formerly mainly employed in the agricultural sector found new jobs in the secondary sector. Further, the accelerated increase in the efficiency of the manufacturing and agricultural sectors led to a rise in the services sector. Salaries of workers in the mining and quarrying industry reflect the increasing efficiency.

Further, the discovery of coal reserves and the outlook of high salaries lead to migration flows of young workers.The terms de/re-territorialisation can help to understend this change in terms of: In one sense rural labour-power was de-territorialised (peasant and landowner), but in another sense, it was re-territorialised (coal miners and factory owners)(Parr, 2010).

A transition from coal and carbon-intensive industries to reduce greenhouse gas emissions have similar consequences. The socio-economic component will analyse the potential impact ofthe energy transition on labour markets and the economic development in the affected regions.

## 1.2. Component key feature

Thefocus of this componentlies onstructural change in the economy, i.e. the reallocation of economic activity across different economic sectors (Herrendorf et al., 2014)and regions. It can lead to a change in aregion's economic, financial and demographic composition. Key concepts of structural change and economic growth[1]concerning the clean energy transition will be adopted. The project will leverage on an approach already developed for assessing structural change at the regional levelin Germany, that is a model[2] that includes energy and non-energy production sectors, regional consumption, regional incomes, labour market dynamics, fiscal transfers between regions, price adjustments and migration. Additionally, the impact of structural change candiffer across gender, e.g.resource shocks in male-dominated sectors can spill over to the rest of the economy (Aragon et al. 2018).

[1] For a review of how the two concepts have been coupled over time seeGabardo, F. A., Pereima, J. B., & Einloft, P. (2017).

[2] Heinisch, Holtemöller and Schult (2020). Power generation and structural change: quantifying economic effects of the coal phase-out in Germany, Energy Economics, URL: https://doi.org/10.1016/j.eneco.2020.105008.

The task will start reviewing the list of factors already considered in the IWH model for Germany and will expand it through a scoping review of the literature on coal and carbon-intensive regions in transition. Given the importance of quantitative data in this dimension, in this task, the available statistical databases will be reviewed as well.

### 1.3. Component synthetic description

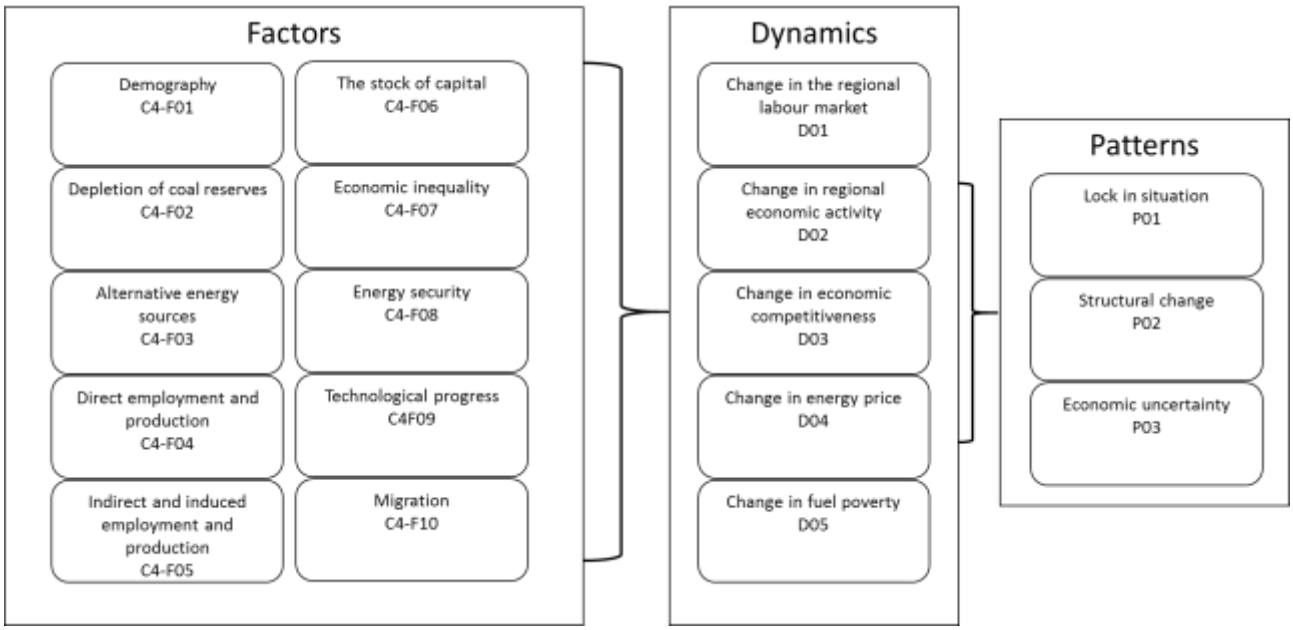
- **Component Lead partner:**Halle Institute for Economic Research (IWH)
- **Overall approach:** Quantitative Economics
- **The domain of enquiry:** The implications of a coal phase-out and the just transition on the economic development of coal and carbon-intensive regions. Mainly the impact of the transformation on the labour market in the specific regions and the overall economic activity. Main indicators of interest are unemployment rates, gross domestic product, migration and labour income.
- **Theory:** General Equilibrium Theory, Dynamic Macroeconomic Theory
- **Primary method:** Quantitative simulations
- **Secondary methods:** Data collection/Text research/Desk research
- **Case diversification:**The selection of case studies allows comparing regions in different stages of the transition process for coal regions. Coal regions in the United Kingdom are at the end of the transition process. German regions already experienced substantial transformation in the past. Polish regions are in the early stage of the transition. For carbon-intensive regions, the diversification is low.
- **Research area definition:** Coal and carbon-intensive regions as classified in the case studies. NUTS-3 regions are the territorial boundaries. For each case study region, a labour market region will be defined based on expert knowledge for each country using NUTS-3 regions.

# 2. Factors, Dynamics and Patterns

## 2.1. Overview

For the socio-economic component, we have identified ten factors that are relevant to economic modelling. Furthermore, we identify five dynamicsfor the interaction among the factors and three patterns.

**Figure 1 – Overview of the factors, dynamics and patterns considered in the socio-economic component**



## 2.2. Factors

### *2.2.1. Demography*

- **Code:** C4-F01
- **Type:** Factor
- **Factor Description:** Demographic change is a common phenomenon in Europe. Economic prosperity and better health care systems lead to an increase in life expectancy. At the same time, fertility rates in European countries declined, leading to a lower share of young people—regions in economic decline experience also greater out-migration of young cohorts.
- **Examples/Indicators:** Life expectancy increased in Germany from 70 in 1960 to 81 years in 2017 (World Bank). The fertility rate declined in Germany from 2.5 in 1960 to 1.5 in 2017 (World Bank).
- **Type of region:** coal and carbon-intensive regions
- **Regions:** all regions
- **Gender-sensitive:** yes, women have a greater life expectancy on average. In Germany, the tendency to migrate from rural to urban areas is for women higher than for men.
- **Primary method:** yes
- **Method(s):** Desk research
- **Internal relations (explained):** It causes and is a consequence of migration (C4-F10). Further mortality and fertility correlate with capital stock (C4-F06) and technological progress (C4-F09).
- **Possible overlap:**
  - Socio-cultural: Ageing population (C1-10)
  - Socio-political
  - Socio-psychological
- **Sources:**Oei, et al., 2020
- **Other comments:**

  Further factors linked to demography are:

  - Education,
    e.g. a significant reduction in the share of the population, both men and women, with tertiary education. This reduction in education may be due to selective migration of more qualified individuals or changes in local education conditions, such as lower returns or lower income. (Aragon et al. 2018)
  - Fertility rate,
    e.g. A study of Austrian plant closures found that job displacement reduced income and job-specific human capital for women in highly skilled occupations, decreasing average fertility by 5-10% (Del Bono et al., 2012)
  - Marital status,
    e.g. "Consistent with ' 'Becker's model of household specialisation, shocks to ' 'male's relative earnings reduce marriage and fertility. (…) these shocks heighten male idleness and premature mortality and raise the share of mothers who are unwed and the share of children living in below-poverty, single-headed households" (Autor et al., 2019)

### *2.2.2. Depletion of coal reserves*

- **Code:** C4-F02
- **Type:** Factor
- **Factor Description:** Remaining reserves in developed countries are less accessible as the former ones. It implies higher mining costs and therefore, higher prices to achieve similar profits.The depletion of coal reserves is one of the key drivers of the coal transition.
- **Examples/Indicators:**Ruhr and Saarland in Germany, South Wales in England, Appalachian region in the United States, Silesia in Poland
- **Type of region:** coal region
- **Regions:** Silesia/Lusatia/Rhineland/Central Germany/Jiu Valley/Sulcis/Upper Nitra/Brindisi /A Coruna/South Wales
- **Gender-sensitive:**no
- **Primary method:** no
- **Method(s):**Desk research
- **Internal relations (explained):** It is related to other dynamics such as a change in economic activity (D02) and economic competitiveness (D04). Further, it stimulates technological progress (C4-F09).
- **Possible overlap:**
  - Socio-technical:
  - Socio-ecological: Sustainability Foresight (C3- F05)
- **Sources:**Galgóczi, 2019; Oei et al., 2019; Brauers & Oei, 2020; Jolley et al., 2019; Rentier et al.,2019

### *2.2.3. Alternative energy sources*

- **Code:** C4-F03
- **Type:** Factor
- **Description:** Coal, as an energy source, faces more competition by other energy sources, such as natural gas or renewables. These energy sources become cheaper and therefore crowd out coal as an energy source. Further, domestic coal production in Europe is more expensive compared to Russia, South Africa or Australia. Low transportation costs of imported coal lead to a decline indomestic coal consumption.The increased competitiveness of alternative energy sources can be considered as one of the key drivers of the coal transition, also leading to dynamcis with clear social impacts.
- **Examples/Indicators:**Replacement of domestic hard coal for imported hard coal in Germany, the UKand Poland.
- **Type of region:** coal region
- **Regions:** Silesia/Rhineland/South Wales
- **Gender-sensitive:** no

- **Primary method:** yes
- **Method**: Desk research
- **Internal relations:** It is related to other dynamics such as a change in the regional labour market (D01), change in economic activity (D02), and change in economic competitiveness (D04).
- **Possible Overlap:**
  - Socio-technical:
  - Socio-ecological: Sustainability Foresight (C3- F05)
  - Socio-psychological:Fair Procedures (C6-05)
- **Sources:**Galgóczi, 2019; Oei et al., 2019; Brauers & Oei, 2020; Jolley et al., 2019

### *2.2.4. Direct employment and production*

- **Code:** C4-F04
- **Type:** Factor
- **Description:** Direct employment effects are changes in the number of workers in the coal and carbon-intensive industry. For instance, a reduction of demand for domestic coal reduces coal production and can reduce the demand for workers in coal mines and power plants. Further, an increase in the automation of coal mining can also reduce the demand for the production factor labour and simultaneously increase production.
- **Examples/Indicators:**i) A reduction of workers in Lusatia and Central Germany after the reunification. Workers have been replaced by machines to increase productivity.ii) A decline of jobs in the coal industry in the UK, because of a higher demand for imported hard coal and lower demand for domestic coal.
- **Type of region:** coal region and carbon-intensive
- **Regions:** all regions
- **Gender-sensitive:** yes, mainly men are employed in the coal industry;therefore, in terms of job-loss, mainly men are affected by the closure of coal mines. However, resource shocks, specific to men, can create negative spillovers to female workers in the rest of the economy, linked to indirect employment (see Aragon et al. 2018)
- **Primary method:** yes
- **Method:** Desk research
- **Internal relations:** It is related to other socio-economic factors and dynamics. The factor triggers indirect employment (C4-F05), migration (C4-F10), and a change in labour markets (D01).
- **Possible Overlap:**
  - Socio-political: Differential incorporation(C3-02), Reconstitution and decline of the organised labour (C3-03)
  - Socio-ecological: Inclusive and multiform governance (C3-F01, C3-F02)
  - Socio-technical
  - Socio-cultural (Tourism C1-F04)
  - Socio-psychological
- **Sources:**Galgóczi, 2019; Oei et al., 2019; Brauers & Oei, 2020; Jolley et al., 2019

### *2.2.5. Indirect,induced employment and production*

- **Code:** C4-F05
- **Type:** Factor
- **Description:**Indirect employmenteffects are changes in the number of workers at the suppliers for the coal and carbon-intensive industry. For instance, a lower output for the coal industry requires less input as well. Therefore, the demand for purchased machines and maintenance services falls as well. The impact on the regions depends on the industrial networks and the dependency of other industries on the coal industry. In addition to the supply chain linkages of industries and firms, the reduction in labour income can reduce consumption expenditure. Reduced consumption expenditure eventually reduces the demand for other products and therefore initiates direct and indirect effects in other sectors. Induced employment and production effects are the results of lower demand as a consequence of lower income in the directly and indirectly affected sectors.
- **Examples/Indicators:** Siemens planned to close down the power turbines factory in Görlitz located in Lusatia as a response to lower demand in the future for power plant turbines. Suppliers for the coal industry rely on the revenues generated by selling their products. The geographical allocation of suppliers might be different across the regions.
- **Type of region:** coal and carbon-intensive region
- **Regions:** all regions
- **Gender-sensitive**: yes, the main suppliers of the coal industries are companies in the manufacturing sector. Here the share of male workers is also higher compared to other industries.For instance, based on data from the UK– after mine closure employment in manufacturing and services increases for men, but decreases for women – men and women are substitutes in non-primary sector labour markets (manufacturing and services), and it leads to a crowding out of women – effects are sizeable. They persist more than 20 years after mine closures (Aragon et al. 2018). Based on data from the US, studies show a" rise in service sector employment, in which women dominate many jobs"(Miewald& McCann, 2004).
- **Primary method:** yes
- **Method:** Desk research
- **Internal relations:** It is related to other socio-economic factors and dynamics. The factor triggers migration (C4-F10), and a change in labour markets (D01).
- **Possible Overlap:**
  - Socio-political: Differential incorporation(C3-02), Reconstitution and decline of the organised labour (C3-03),
  - Socio-ecological and -technical: Inclusive and multiform governance (C5-F01, C5-F02)
  - Socio-cultural
  - Socio-psychological
- **Sources**: Galgóczi, 2019; Oei et al., 2019; Brauers & Oei, 2020; Jolley et al., 2019

### *2.2.6. Stock of capital*

- **Code:** C4-F06
- **Type:** Factor

- **Description:** The carbon-intensive industries increase the concentration of GHG in the atmosphere. But the mining of coal destroys the local environment. Further, it is not only the destruction of farming land or forests but also the relocation of towns and villages. Therefore, the coal mining process has direct implications of the available natural and physical capital stock. Further, the coal and carbon-intensive industries are important sources of tax revenues. Local tax revenues finances public infrastructure. A decline increases the dependency on fiscal transfers from other regions to maintain the public capital stock.
- **Examples/Indicators:** In the coal region, Rhineland demonstrators wanted to preserve the Hambach forest. The extraction of coal from the ground underneath requires the relocation ofvillages and towns in Lusatia. A decline in sales by Vattenfall in Lusatia lead to lower local tax revenues.
- **Type of region:** all regions
- **Regions:** Lusatia/Central Germany/Rhineland/Silesia/South Wales/Jiu Valley/SulcisIglesiente/Upper Nitra
- **Gender-sensitive:** no
- **Primary method:** no
- **Method:** Desk research
- **Internal relations:** The factor triggers economic inequality (C4-F07), change in economic competitiveness (D04) and migration (C4-F10).
- **Possible Overlap:**
  - Socio-ecological and -technical,
  - Socio-political,
  - Socio-psychological
  - Socio-cultural: Transfers and subsides (C1-09)
- **Sources:**Oei et al., 2019; Brauers & Oei, 2020
- **Other comments:** Economists refer to natural capital also as natural resources.

### *2.2.7. Economic inequality*

- **Code:** C4-F07
- **Type:** Factor
- **Description**: Economic inequality refers to the phenomenon of an uneven distribution of income or wealth. Coal miners and workers in the carbon-intensive industry receive above-average wages and therefore have higher incomes compared to other workers. It leads to economic inequality concerning labour income.
- **Examples/Indicators:** In Lusatia, the average wage is only half of the average wage in the coal industry.
- **Type of region:** coal and carbon-intensive region
- **Regions:** all regions
- **Gender-sensitive:** yes

Coal miners are mainly men. Other occupations have lower average wages which contribute to the gender wage gap.

- Mine closures reduce wages in non-primary sectors (Aragon et al., 2018):
  - in manufacturing the reduction is similar for both men and women,
  - in services, it is only significant for men – Negative and significant effect on men's wages in retail, catering, and other industries in which men and women seem to be more substitutable.

Increase in economic inequality can lead to changes in intra-household bargaining power, and

- an increase in domestic violence (Aizer, 2010)

- **Primary method:** no
- **Method:** Desk research
- **Internal relations:** It triggers migration (C4-F10), change in the regional labour market (D01), change in regional economic activity (D02) and change in fuel poverty (D03).
- **Possible Overlap:**
  - Socio-cultural: Top-down development projects (C1-08)
  - Socio-psychological,
  - Socio-political
  - Socio-ecological and -technical: Working across political-administrative levels and geographical scales (C5-F10)
- **Sources:**Oei et al., 2019; Brauers & Oei, 2020

### *2.2.8. Energy security*

- **Code:** C4-F08
- **Type:** Factor
- **Description:** Energy security depends on a reliable supply of electricity and heat. Fossil fuels are the most important energy source for Europe. Renewable energy sources are mainly intermittent and therefore, less reliable. So far, it is not possible to run the electricity grid using only renewables. Energy storage facilities are required to compensate for the loss in reliable energy sources. Coal power plants need more time than gas-fired power plants until they can supply electricity. To maintain energy security, a fuel switch from coal to gas seems likely.
- **Examples/Indicators:** Every Eastern in Germany, the share of renewables is high, and the demand for electricity low. Coal-fired power plants are not able to get off the grid fast enough, which leads to an oversupply of electricity.
- **Type of region:** coal and carbon-intensive region
- **Regions:** all case studies
- **Gender-sensitive:** no
- **Primary method:** no
- **Method:** Desk research

- **Internal relations:** It is related to the depletion of coal reserves (C4-F02), technological progress (C4-F09), and change in the price of energy (D05).

- **Possible Overlap:**
  - Socio-political,
  - Socio-psychological

- **Sources:**Brauers & Oei, 2020

### *2.2.9. Technological progress*

- **Code:** C4-F09

- **Type:** Factor

- **Description:** Technological progress is a long-run trend, which describes the ability to produce more output for a given number of production factors. The history of the coal industry in Europe shows a dramatic increase in labour productivity, measured as mined coal intonnes concerning employment in the sector. This shift in demand for production factors leads to the creation of companies supplying the machines to the coal companies. Further, it allows increasing the total quantity of mined coal such that the price of coal and electricity fell dramatically. Greater mechanization and new mining techniquesare among the factors contributing to the steady decline of emplyment in the coal mining sector.

- **Examples/Indicators:** After the reunification, the restructuring of the German lignite industry in East Germany led to massive unemployment.

- **Type of region:** coal and carbon-intensive region

- **Regions:** all case studies

- **Gender-sensitive:** no

- **Primary method:** yes/no

- **Method:** Desk research

- **Internal relations:** It is related to other socio-economic factors and dynamics. Technical progress triggers direct employment effects (C4-F04), indirect employment effects (C4-F05), change in regional labour markets (D01) and a change in regional economic activity (D02).

- **Possible Overlap:**
  - Socio-cultural: Automation of work (C1-F18)
  - Socio-psychological:Fair Procedures (C2-05)
  - Socio-ecological and -technical: Empowered and autonomous communities in practice (53-F03), Innovation embedding and coupling (C2-F07)

- **Sources:**Brauers & Oei, 2020; Kok, 2017; Fothergill, 2017; Oei et al., 2020; Oei et al., 2019

### *2.2.10. Migration*

- **Code:** C4-F10

- **Type:** Factor

- **Description:** Migration is a response to changes in the environment. In modern economies, migration is essential to balance our demand and supply on the labour market. For instance, some of the coal regions have been sparsely populated before the discovery of the different applications of coal. In the last decades, the role of the coal industry as an employer decreased. Young cohorts started to out-migrate again.

- **Examples/Indicators**: The population in Lusatia increased tremendously in the 1950s and declined after the reunification in the 1990s.

- **Type of region:** coal and carbon-intensive regions

- **Regions:** all regions

- **Gender-sensitive:** yes, Women are more likely to migrate from rural areas to urban areas. For instance, based on data from the UK– mine closure leads to a relative decrease in male-female population in the area - a significant change in gender composition: there is a drop in the share of women in the total population. Mine closure leads to an increase in the share of single, unmarried, individuals(Aragon et al. 2018).

- **Primary method:** yes

- **Method:** Desk research

- **Internal relations:** It is related to other socio-economic factors such as demography (C4-F01), direct and indirect employment (C4-F04, C4-F05), economic inequality (C4-F07), change in the regional labour market (D01) and change in regional economic activity (D02).

- **Possible Overlap:**
  - Socio-cultural:
    - Cultural-induced youth out-migration (C1-01)
    - Aged out-migration(C1-02)
    - In-migration (C1-03)
  - Socio-psychological
  - Socio-political
  - Socio-ecological and -technical: Empowered and autonomous communities in practice (C3-F03)

- **Sources:**Strambo et al., 2019; Bohlmann et al., 2019; Fleming-Muñoz et al., 2020

## 2.3. Dynamics

### *2.3.1. Change in regional labour market*

- **Code:** D01

- **Type:** Dynamic

- **Description:** Direct and indirect employment effects will trigger a change in the regional labour markets. In the short run, unemployment rates are very likely to increase in the regions. In the long run, young cohorts will respond to structural unemployment rates above the national averages by migrating to other regions. At the same time, the expansion of alternative energy carriers could trigger an increase in direct and indirect employment effects, at least in the short run. But this might counteract the negative direct and indirect employment effects. Therefore, the overall effect is ambitious.

- **Examples/Indicators:** See Examples/Indicators for factor C4-F04 and C4-F05.

- **Type of region:** coal and carbon-intensive region
- **Regions:** all regions
- **Gender-sensitive:** yes, gender-related consequences were mentioned in the factors above
- **Primary method**: yes
- **Method:** Desk research
- **Internal relations:** It is a consequence of direct and indirect employment (C4-F04, C4-F05) as well as demography and migration (C4-F01, C4-F10).
- **Possible Overlap:**
  - Socio-political,
  - Socio-technical,
  - Socio-cultural,
  - Socio-psychological
- **Sources:** Oei, Brauers, & Herpich, 2020; Strambo, Aung, & Atteridge, 2019; Fleming-Muñoz et al., 2020; Galgóczi, 2019; Oei et al., 2019; Bohlmann et al. 2019; Fothergill, 2017
- **Other comments:**
  - The overall effect, which is a direct consequence of and builds upon gender-sensitive factors such as in/direct employment, demography, and migration, will result in a gender-sensitive manner, too.
  - **"**The analysis shows that the impetus towards greater gender equality in the household is constrained by a stagnant and stable labour market gender regime"."(Bamberry, 2016)

### *2.3.2. Change in regional economic activity*

- **Code:** D02
- **Type:**Dynamic
- **Description:** Direct and indirect economic effects of energy transformation has consequences for the development of the regional economic activity. This change can be measured using different metrics. The most frequently used metric is GDP. The effect of a coal phase-out on regional GDP is **highly likely negative in the short run, but it is ambiguous what the effect is in the long run.**
- **Examples/Indicators**: Direct and indirect employment effects lead to the closure of old and opening of new enterprises and businesses in the case study regions.
- **Type of region:** coal and carbon-intensive region
- **Regions:** all regions
- **Gender-sensitive:**yes
- **Primary method:** yes
- **Method:** Desk research

- **Internal relations:** It is a consequence of direct and indirect employment (C4-F04, C4-F05) as well as demography and migration (C4-F01, C4-F10).
- **Possible Overlap:**
- **Sources:** Bohlmann et al., 2019; Oei, et al., 2020; Fleming-Muñoz et al., 2020

### *2.3.3. Change in economic competitiveness*

- **Code:** D04
- **Type:** Dynamic
- **Description:** The economic competitiveness of coal and carbon-intensive regions will change. For instance, coal regions already experienced a change in their economic competitiveness. The depletion of coal reserves, which are easy to access and the expansion of alternative energy sources, will change the relative economic competitiveness of the regions. The ongoing transformation in the coal regions is also caused by higher costs of extracting coal from less geographically favourable basins.
- **Examples/Indicators:** An increase in hard coal imports in the Ruhr area as a consequence of relatively more expensive coal mining activities in the Ruhr area.
- **Type of region:** coal and carbon-intensive regions
- **Regions:** all regions
- **Gender-sensitive:**yes, see 'other 'comments'
- **Primary method:** no
- **Method:** Desk research
- **Internal relations:** Is a consequence of alternative energy sources (C4-F03) and depletion of coal reserves (C4-F02).
- **Possible Overlap:**
    - Socio-political,
    - Socio-cultural,
    - Socio-technical
- **Sources:** Galgóczi, 2019; Oei et al., 2019; Brauers & Oei, 2020; Strambo et al, 2019; Jolley et al, 2019
- **Other comments:**
    - Change in economic competitiveness is 'stressing both the marketization of social reproduction and the need to expand ' 'women's productive roles are constantly brought into tension with embedded social 'structures'(Elias, 2011).
    - 'The gender and competitiveness frame is potentially useful to those seeking to promote greater attention to gender issues across other government ministries. But at the same time, such an instrumentalist approach is profoundly limiting, failing as it does to move beyond the 'business 'case'for gender equity and to engage with a broader range of gender issues such as ' 'women's human rights, and is easily resisted through recourse to traditionalist discourses concerning ' 'women's innate socially reproductive responsibilities. The persistence of traditionalist understandings of ' 'women's family roles and responsibilities

within the state underscores the extent to which economic restructuring remains embedded within localised gender ideologies that are cross-cut with notions of ethnicity and religion. Thus, an increased emphasis on ' 'women's role as productive knowledge workers potentially conflicts with government policies that emphasise 'wives'and 'mothers'responsibilities in supporting productive and morally upstanding 'citizens'(Elias, 2011).

### *2.3.4. Change in price ofenergy*

- **Code:** D04
- **Type:** Factor
- **Description:** The supply of electricity from the coal regions currently determine electricity prices in their respective country. Marginal costs of electricity generated by burning lignite are the lowest among all energy sources used to produce electricity in Germany. Electricity generation by coal has implications for the electricity price paid by consumers. European electricity grids allow providing electricity to other regions. But local electricity prices are still different depending on the operator of the grid and the specific energy mix.
- **Examples/Indicators:** Electricity prices increased in Germany since the introduction of the ErneuerbareEnergienGesetz (EEG 2000). There is not a single cause for higher wholesale electricity prices. Transforming the electricity grid has different implications for the costs associated with it.[3]
- **Type of region:** coal region and carbon-intensive regions
- **Regions:** all regions
- **Gender-sensitive:** yes
- **Primary method:** no
- **Method:** Desk research
- **Internal relations:** It responds to the depletion of coal reserves (C4-F02) and alternative energy sources (C4-F03).
- **Possible Overlap:**
  - Socio-political,
  - Socio-ecological and -technical
- **Sources:**Oei et al., 2019; Brauers & Oei, 2020; Bohlmann et al., 2019
- **Other comments:** Fuel poverty affects disproportionally women. This means that changes in the price of energy can affect the well-being of women more than men.

### *2.3.5. Change in fuel poverty*

- **Code:** D05
- **Type:** Dynamic

[3] https://www.stromauskunft.de/strompreise/strompreis-atlas/

- **Description:** Fuel poverty depends on economic inequality. Economic inequality and changes in energy prices can either amplify or reduce fuel poverty. Lower-income groups spend a higher share of their income on energy consumption.Decarbonisation of the electricity sector can lead toa change in the price of energy.It can also change the share of income spent on energy consumption. This can further increase economic inequality.
- **Examples/Indicators:** Changes in electricity prices in Germany mainly affect low-income households compared to high-income households. Higher-income households have more disposable income to purchase less energy-intensive devices and spend in relative terms less on energy.
- **Type of region:** coal and carbon-intensive region
- **Regions:** all regions and non-coal and CO2 regions.
- **Gender-sensitive:**yes, women are at greater risk of energy poverty than men, e.g. due to lower-income (Clancy et al., 2017)
- **Primary method:** no
- Me**thod:** Desk research
- **Internal relations:** Economic inequality (C4-F07) and change in the price of energy (D05) trigger change in fuel poverty.
- **Possible Overlap:**
  - Socio-cultural,
  - Socio-political,
  - Socio-psychological
- **Sources:**(Brauers & Oei, 2020; Kok, 2017; Bohlmann, Horridge, Inglesi-Lotz, Roos, & Stander, 2019)

## 2.4. Patterns

### *2.4.1. Lock-in situation*

- **Code:** P01
- **Type:** Pattern
- **Description:** The preservation of the status quo is a typical response to multiple factors and dynamics. This pattern is mainly a consequence of the denial to acknowledge the need for change. Even maintaining the status quo costs resources not available to adapt to the new situation. A potential consequence is lower economic competitiveness than usual. Lower economic competitiveness can lead to the decline of a region destroying communities and social networks.
- **Examples:** The Ruhr area in Germany and the Silesia region in Krakow tried to preserve the coal industry using subsidies.
- **Type of region**: coal and carbon-intensive region
- **Regions:** all regions
- **Gender-sensitive:** no
- **Primary method:** no

- **Method:** Desk research
- **Internal relations:** It is related to all other socio-economic factors (C4-F01 to C4-F10) and dynamics (D01 to D05). Further, it determines the speed of structural change (P02).
- **Possible Overlap:**
  - Socio-cultural,
  - Socio-psychological,
  - Socio-political,
  - Socio-ecological and -technical

  **Sources:** Galgóczi, 2019

### *2.4.2. Structural change*

- **Code:** P02
- **Name:** Structural Change
- **Type:** Pattern
- D**escription:** Structural change is the reallocation of economic activity across different economic sectors (Herrendorf et al. 2014). It leads to a fundamental change in the composition of the economic structure. It is a consequence of multiple factors, such as technological progress, change in competition and demography. Developed economies mainly experienced a shift from the agricultural sector to the manufacturing and services sectors. First, the industrial revolution led to a reallocation of employment from the agricultural sector to the manufacturing sector. Second, the transformation of modern economies from secondary to tertiary industriesinitiated the next big wave of reallocation. The energy transition has the potential to change economic activity in the mining and quarrying sector. However, it is not clear what the net effects on the specific sectors are.
- **Examples:** In Central Germany, after the reunification, the chemical and coal industry adopted new technologies. This led to a lower dependency of the region on the industrial economic activity.
- **Type of region:** coal and carbon-intensive region
- **Regions:** all regions
- **Gender-sensitive:** no
- **Primary method:** no
- **Method:** Desk research
- **Internal relations:** It is related to all socio-economic factors, dynamics and patterns.
- **Possible Overlap:**
  - Socio-cultural,
  - Socio-psychological,
  - Socio-political,
  - Socio-ecological and -technical
- **Sources:** Oei, Brauers, & Herpich, 2020; Kok, 2017; Strambo et al., 2019; Bohlmann et al., 2019; Oei, et al., 2020

### *2.4.3. Economic uncertainty*

- **Code:** P03
- **Type:** Pattern
- **Description:** Economic uncertainty describes the phenomenon of less predictable economic developmentdue to structural change. This includes consumption, labour market and investment decisions of households as well as investment decision of firms. But it also affects the planning process of governments.
- **Examples:** The commission for economic growth and structural change in Germany and the public debate about the coal phase-out took several years. It further leads to lower investments because of uncertainty about future development.
- **Type of region:** coal and carbon-intensive regions
- **Regions:** all regions
- **Gender-sensitive:** no
- **Primary method:** yes
- **Method:** Desk research
- **Internal relations:** It is related to all socio-economic factors, dynamics and patterns.
- **Possible Overlap:**
  - Socio-cultural,
  - Socio-psychological,
  - Socio-political,
  - Socio-ecological and -technical
- **Sources:** Strambo et al., 2019

# 3. Literature overview

## 3.1. Overview

We can broadly distinguish between papers analysing the structural change in general and papers analysing energy transitions, especially previous coal phase-outs(Rentier et al., 2019; Strambo et al. 2019; Fouquet, 2016; Oei, Brauers, & Herpich, 2020).

### *3.1.1. Structural change and economic growth*

Structural change is a dominant issue in the economic literature, especially in the economic growth literature. One of the main endeavours of theoretical growth models is the explanation of so-called stylised facts(Kaldor, 1957). Various scholars updated these facts over time(Jones, 2016; Jones & Romer, 2010). It is necessary to learn from historyto manage future structural change and to avoid the repetition of previous mistakes. Theoretical models are a tool to reduce the complexity of the real world and to conduct thought experiments. A basic model able to meet some of the stylised facts is the neo-classical growth model. The model has a balanced growth path ensuring a constant growth rate of all variables.

Nevertheless, structural change and economic growth have occurred at the same time in the past. Developed economies experienced roughly constant growth rates and a reallocation in economic activity among different sectors. A decline of relative economic activity in the agricultural sector, an inverse U-shaped development of the manufacturing share and a steady increase in the services sector share has been observed (Acemoglu, 2009). The standard one-sector neoclassical growth model can not incorporate structural change. Therefore, the model is extended to feature multiple sectors. There are multiple ways to combine a theoretical model meeting the stylised facts and featuring structural change (Herrendorf et al., 2014). It is common to restrict neoclassical growth models to the ones featuring balanced growth paths. This seems to be too restrictive in order to combine structural change and economic growth. Therefore, the socio-economic component will use a multisectorgrowth model to replicate the stylised facts with approximately balanced growth on the aggregate level, but non-balanced growth on the sectoral level.

Another issue regarding structural change and economic growth is the regional heterogeneity observed in the data(McMillan et al., 2017). Developed economies experience different structural change leading to different economic growth. The energy transition in Europe is a special case of structural change with heterogenous consequences for individual regions. We will analyse the potential economic consequences for different regions using a multisector and multiregional economic growth model based on the literature on economic growth and structural change.

### *3.1.2. Energy Transition*

The political economy literature analyses the interaction between politics and the economic system. Fouquet (2016)describes the historical development of energy transition. Energy demand is the key driver for the development of the current energy system. At the beginning of the transition process, electricity and other forms of energy were luxury goods. Today, the incumbents in the energy industry are an obstacle for market

entry. Therefore, subsidies for new entrants in the market providing green energy seem to be necessary. The transition process already started in many regions in Europe. However, it is obvious that regions/nations with a higher dependency on coal are less willing to start the transition process. Poland still depends heavily on coal as an energy source, and the political system still resists the transition (Brauers & Oei, 2020).One main reason for the political system to postpone the transition process is economic uncertainty, which depends positively on the dependency of coal (Strambo et al., 2019). The general economic system might decide about the speed and social-economic consequences of the energy transition. In general liberal market economies (LMEs) tend to adapt faster to new technologies than central market economies (CMEs) (Rentier et al., 2019).In order to estimate the potential impact of the energy transition on coal and carbon-intensive regions, it is necessary to quantify the current contribution of the coal industry to the regional economies.

### *3.1.3. Gender*

Generally, sex- and gender-informed perspective increases rigour, promotes discovery, reflects realities and expands the relevance of research (EU, 2019). Resource shocks, specific to men, can create negative spillovers to female workers in the rest of the economy (Aragon et al. 2018). Furthermore, understanding gender-specific effects in the labour market are important given the evidence linking women's relative labour opportunities to a host of other outcomes such as their political influence, intra-household bargaining power, includinghigher intra-household violence rates against women with increasing gender wage gap (Aizer, 2010) and fertility and children's well-being (Del Bono et al., 2012).

## 3.2. Key Papers for Structural Change and Economic Growth

### *Acemoglu, 2009: Introduction to Modern Economic Growth, Chapters 20 and 21*

Both chapters deal with unbalanced economic growth andtheir potential reasons. First, it is possible that unbalanced economic growth is driven by the demand side. Preferences differ for goods from different sectors, which eventually leads to different expenditure shares and, therefore, different employment and value-added shares. Second, unbalanced economic growth can also be the result of different growth rates of the different economic sectors. One reason is different production functions, which imply different factor intensities. Supply and demand-side reasons for structural change can be present at the same time. The structural transformation will also trigger changes in migration flows and more general in demographics.

### *Herrendorf, Rogerson, & Valentinyi, 2014: Growth and structural transformation*

There are different ways to replicate the stylised factsof economic growth in a model. However, a combination of economic growth and structural transformation in a model with balanced growth seems to be too restrictive. Models should focus on approximately balanced growth rather than on unbalanced growth.

### *Jones, 2016: The facts of economic growth*

This paper adds and modifies the six stylised facts by Kaldor. The ratio of physical capital to GDP is relatively stable over time. In recent years labour and capital shares on national income reveal a weak trend. Further, years of schooling increased over time, which leads to more human capital. Research and development spending increased in relation to GDP since the 1930s. At the same time, the research employment share increased in the US and OECD countries. Further, employment and value-added share in agriculture tremendously decreased.

### *Jones & Romer, 2010:The new Kaldor facts: Ideas, innovation and human capital*

In addition to the facts revealed by Kaldor, this paper focuses on the empirics of ideas, institutions, population and human capital. First, an increase in the extent of markets can be observed. Second, growth accelerates for GDP and population. Third, growth rates increase the further away an economy is from the technological frontier. Fourth, not the production factor inputs explaindifferences in economic activity rather total factor productivity and technology can explain it. Fifth, human capital increased over time. Sixth, relative wages have been stable for a long time.

### *Kaldor, 1957: A model of economic growth*

The seminal paper by Kaldor can be summarised by stating the stylised facts enumerated in the paper.First, annual output per worker grows at a constant rate. Second capital per worker grows at a constant rate identical to the one for output per worker. Third, the capital-output ratio is roughly constant. Fourth, the rate of return on capital is constant. Fifth, the share of capital and labour on income is constant. Sixth, real wages grow over time.

### *McMillan, Rodrik, & Sepulveda, 2017: Structural change, fundamentals and growth: A framework and case studies*

The story of economic growth in developing countries is not the same for all respective countries. This paper looks at seven different countries: Botswana, Ghana, Nigeria, Zambia, India, Vietnam and Brazil. The reason for their rapid growth rates in the last century differs. Vietnam is the country showing a strong increase in the manufacturing sector leading to export-driven economic growth. African countries could not follow this approach and experience lower growth rates.

## 3.3. Key Papersfor Energy Transition

### *Fouquet, 2016: Historical energy transitions: Speed, prices and system transformation*

The paper studies the rise of fossil fuels. New energy sources replaced old ones mainly as a luxury good. For the transformation and adaptation speed demand seems to be more important than supply. Of course, supply needs to be able to meet demand, but without an increase in demand for energy supply to drive or light the house, oil and coal would not have replaced wood or hydropower. Renewables are unlikely to replace fossil fuels as fast as fossil fuels replaced older energy sources. Here lock-in mechanisms will prevent a fast transformation. The role of the government to foster the transformation by subsidising renewables seems to be necessary. However, the paper does not report any factors. It focuses more on the dynamics and patterns of energy transitions.

### *Fouquet, 2016: Phasing out coal – a just transition approach.*

In 2017 about 170,000 jobs in the EU28 were directly related to the coal industry. Including indirect jobs, the total number is above 300,000 jobs. The main findings are that workers will face the risk of reemployment or retire earlier.Companies face reputational, financial and strategic risks.The Ruhr transition see factors, dynamics and patterns.Speed of transition, price of energy services, benefits consumer may gain, the role of government internalising the external costs of pollutants, the type of industry, other transformation that will ensure and inequality that may occur.

### *Oei et al., 2019: Phasing Out Coal in The German Energy Sector*

The paper clearly states an interdependency between open cast mines for lignite and power plants. Opencast mines need a minimum extraction rate to cover their fixed costs. A CO2 price above 20 EUR is able to make lignite coal production unprofitable. Cost and benefits of the coal phase-out are reported as follows:

| Costs | Benefits |
|---|---|
| A slight increase in the wholesale price of electricity | Towns and cities threatened to be relocated remain. |
| Redundancy plan costs for coal industry employees | Fewer air pollutants lead to lower environmental and health costs. |
| Lower trade tax revenues for some municipalities | |

### *Brauers & Oei, 2020: The political economy of coal in Poland: Drivers and barriers for a shift away from fossil fuels.*

The Triple Embeddedness Framework (TEF) analyses the political economy in Poland and the coal phase-out. The framework considers three dimensions socio-political, economic environment analysis and external and internal response strategies of the coal regime. Different stakeholders oppose a coal phase-out in Poland. The coal industry is still an important employer and also provides community services. Therefore, these companies are crucial for the economic as well as the social system in Poland. However, external political forces and less profitable coal reserves increase the pressure to start the transition.

### *Fothergill, 2017: Coal Transition in the United Kingdom*

The UKwas the first country to use coal as an energy source and is now one of the first European countries phasing-out coal. A CO2 tax is the main instrument to achieve a reduction in coal consumption. However, the government accompanied the introduction of the CO2 tax with redundancy payments, welfare benefits, and early access to pensions. The transition process reveals that high-paid coal mining jobs are mainly replaced by low-paid jobs. A general decline in regional wage levels is the consequence. Further, fewer people are in the active labour force, and fewer firms operate in former coalfield regions.

### *Oei, Brauers, & Herpich, 2020: Lessons from Germany's hard coal mining phase-out: policies and transition from 1950 to 2018*

This paper analyses the coal phase-out in the German regions Ruhr and Saarland. Both regions experienced a main economic structural change as a consequence of lower competitiveness of domestic hard coal reserves. The result of the study is that the transformation process depends on **multiple factors**.

### *Kok, 2017*: Coal *Transition in the United States – An historical case study for the project "Coal Transitions: Research and Dialogue on the Future of Coal")*

The paper analyses the crash of major US coal companies due to declining demand for UScoal. Further, it shows the issue of underfunded state budgets, because of high health care, retirement and reclamation liabilities from bankrupt coal companies. This will leave less disposable state funds to support the transition and structural change.

### *Strambo, Aung, & Atteridge, 2019: Navigating coal mining closure and societal change: learning from past cases of mining decline*

They specifically examined the following categories of impacts to capture the social, economic and political factors associated with mining decline: economic development, employment, demographics, social structures, culture and identity, infrastructure, urban and land planning, and (geo)politics and security. We noted other types of impacts when mentioned.Mine closures, policy measures and migration can lead to economic uncertainty.

### *Bohlmann, Horridge, Inglesi-Lotz, Roos, & Stander, 2019: Regional employment and economic growth effects of South Africa's transition to the low-carbon energy supply mix*

The paper studies the impact of a reduction in electricity generation by coal in South Africa. One main obstacle is that the transition to renewables requires more formal training than currently provided. One can anticipate a decline in GDP due to a drop in coal prices and produced quantity.

### *Oei, et al., 2020: Coal phase-out in Germany – Implications and policies for affected regions*

This paper first provides an overview of the coal industry in the German regions. It focuses mainly on the lignite industry. In 2014 mainly the lignite industry still mined. The regions considered are Lusatia, Central Germany and Rhineland. Coal phase-out scenarios are defined based on the results of an electricity market model. A coal phase-out until 2035 and 2040 is considered. Regional economic effects of a coal phase-out in Germany shows that feasible coal phase-out paths will trigger out-migration in coal regions and a loss in wages. Further, a phase-out until 2040 is not worse than a phase-out until 2035. The recovery is mainly driven by new economic activity in non-coal regions.

### *Fleming-Muñoz, Poruschi, Measham, Meyers, & Moglia, 2020*: Latent economic vulnerability to mitigation

The paper analyses regional vulnerability in Australia to mitigation policies to reduce GHG emissions by fossil fuels. It develops the LEVER index (latent economic vulnerability to emissions reductions). The LEVER index consists of two subindices. Carbon Economic Exposure index (CEE) is the proportion of jobs dependent on carbon-intensive industries: Jobs in agriculture (sheep, beef cattle and grain farming; dairy cattle farming); manufacturing (pulp, paper and paperboard manufacturing; petroleum and coal product manufacturing; glass and glass product manufacturing; cement, lime, plaster and concrete manufacturing; primary metal and metal product manufacturing); mining (coal mining; oil and gas extraction); and electricity, gas, water and waste services (fossil-fuel electricity generation). The second index is Carbon Economic Resilience (CER), which reflects the proportion of employment of export-oriented low-GHG-intensive sectors: agriculture (all employment excluding jobs in sheep, beef cattle and grain farming; dairy cattle farming); manufacturing (all employment excluding cement, lime and concrete; petroleum refinery; glass production; pulp and paper manufacturing; primary metal production); mining (all employment excluding coal mining; oil and gas extraction); and tourism. The Lever index is the ratio between CEE and CER.

***Rentier, Lelieveldt, & Kramer, 2019: Varieties of coal-fired power phase-out across Europe***

The paper compares coal phase-outs between centralised market economies (CME) and liberalised market economies (LME).LMEs are more likely to phase-out coal than LMEs, but here we compare the UKwith central Europe.

### 3.4. Key Papers for Gender Issues in coal and energy sector

***Aragón, et al, 2018: Resource shocks, employment, and gender: evidence from the collapse of the UKcoal industry***

This paper examines the effect of resource shocks on non-primary employment by gender.Based on data from the UK,the authors show that the effects aredifferent for men and women: when a mine closes, employment in manufacturing and servicesincreases for men but decreases for women. Population size and wages are also negativelyaffected. The effects are sizeable and persist more than 20 years after mine closures. Theseresults are consistent with men and women being imperfect substitutes in the labour marketand highlight the importance of considering gender issues when assessing the economicimpact of natural resources.Mine closure leads to an increase in the share of single, unmarried individuals. Women are more likely to migrate from rural areas to urban areas.The reduction in education may be due to selective migration of more qualified individuals or changes in local education conditions, such as lower returns or lower income.

***Clancy et al., 2017: Gender perspective onaccess to energy in the EU***

The paper shows that within the EUwomen are at greater risk of energy poverty than men, e.g. due to lower-income. Interpretation and implementation of EU legislation atthe national level are also investigated. Possible opportunities to ensure that policiesand interventions to address energy poverty are more gender-aware are identifiedand discussed.

***Aizer, 2010: The gender wage gap and domestic violence***

By exploiting exogenous changes in the demand for labour in female-dominated industries to male-dominated ones, she estimates the impact of the gender wage gap on violence against women. She shows that an increase in economic inequality can lead to changes in intra-household bargaining power and an increase in domestic violence

***Miewald & McCann, 2004: Gender struggle, scale, and the production of place in the Appalachian coalfields***

As the traditionally male-dominated mining industry has seen a reduction inemployment, there has been a parallel rise in service sector employment, in which women dominatemany jobs.Based on data from the US, the authors discuss how this economic restructuring has produced a series of struggles between men andwomen over appropriate gender roles relating to waged work and household work. The paper contributesto ongoing discussions of the social production of place and the politics that surround this process.

***Del Bono et al., 2012: Clash of career and familiy: Fertility decisions after job displacement***

The authorsanalyse how career considerations may affect fertility decisions in the presence of a temporary employment shock. They compare the birth rates of women displaced by anAustrian plant closure with those of women unaffected by job loss after establishing the pre-displacement comparability of these groups. The results reveal that job displacement reduces average fertility by 5%-10% and that these effects are largely explained by the response of women in more skilled occupations.

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# ANNEX 5

## Socio-Ecological and Technical Component

Short Report on Key Factors, Dynamics and Patterns

# Document Control Sheet

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|---|---|
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|---|---|
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## Table of Contents

# 1. The Socio-Technical and Socio-Ecological Component

"Nature in the twenty-first century will be a nature that we make; the question is the degree to which this moulding will be intentional or unintentional, desirable or undesirable"

– Daniel Botkin

## 1.1. Introduction

This joint component seeks to leverage the insights of socio-ecological and socio-technical systems thinking to assess the transformative capacity available in case study regions, focusing on the respective regional economic development system involved in shaping their decarbonisation pathways. In principle, different future decarbonisation pathways are always possible. The focus on transformative capacity allows us to discern in how far a region is actually able to deviate from its current (carbon-intensive) path. This enables interpretations regarding (a) challenges faced and the utility of the coping strategies employed, (b) implications in terms of de-territorialisation, and (c) policy options driving re-territorialisation and transformative decarbonisation.

Transformative capacity can be broadly defined as "the capacity to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable" (Walker, Holling, Carpenter &Kinzig 2004). More specifically, it is understood here as the "type of power that effectuates deep and holistic [regional] change, resulting from particular forms of agency and interactions in a given institutional and spatial-material setting" (Wolfram et al. 2019). Transformative capacity "forms a qualitative and contingent measure of [regional] system dynamics describing a set of key parameters concerning actors, institutions, physical environs, and their interaction processes. As such it depicts an evolving collective ability to conceive of, prepare for, initiate and perform path-deviant [regional] change" (ibid.).

## 1.2. Component key features

The transformative capacity framework has been developed, *inter alia*, from research which seeks to understand stability and change in coupled socio-ecological systems (SES) and socio-technical systems (STS). These interdisciplinary fields of research are based on the premise that SES and STS are complex adaptive systems, which implies that they are characterised by emergence, self-organisation, co-evolution, and non-linearity. They do not change in a predictable, linear, incremental fashion, but may abruptly switch into alternate regimes (as a result of endogenous dynamics or exogenous pressures) in which their function, structure, and feedbacks are different. These approaches offer a strong alternative to those that inadequately theorise sustainability in terms of independent sectors (economy, society, environment) with "underlying assumptions of reducibility, linear trade-offs or synergies and separability" (Reyers et al. 2018).

This systems approach has been usefully applied in SES to understand the dynamics of social-ecological systems and thus promote resilience-based adaptive management paradigms, as well as perspectives that seek to ensure a "safe [and just] operating-space for humanity" (Rockström 2009; Raworth 2012), in which social needs can be met without overshooting planetary boundaries. It also finds a conceptual antecedent in the landmark *Limits to Growth* (Meadows et al. 1972) report, which first questioned the long-term sustainability of our current economic trajectory from a systems perspective.

The socio-technical approach to sustainability transitions includes a range of interdisciplinary perspectives that consider the evolution and transformation of large-scale systems through which key societal needs are fulfilled (e.g., electricity, heat, mobility, agro-food). The cumulative lifecycle impacts of such systems contribute to between 70 and 80 per cent of global environmental problems. The resolution of the problems brought about by unsustainable production and consumption patterns in these socio-technical systems comprise grand societal challenges, which cannot be addressed by incremental improvements and technological fixes, but require radical shifts to new kinds of socio-technical systems. A central aim of sustainability transitions research is to conceptualise and explain how radical changes can occur in the way societal functions are fulfilled.

It is important to note that although the systems perspective is shared, theory developed in each of the two approaches pertains to different kinds of system. SES draws inspiration from systems ecology, while STS draws on evolutionary economics, sociology of technology, and institutional theory to examine the evolution of socio-technical systems within what is ultimately a growth-based economic system. The SES perspective can shed light on the contradiction between such a system and the biosphere within which it is embedded. For instance, a systemic shift to biofuels can be analysed using the STS paradigm as breakthrough in sustainable energy production, but it will be very differently viewed by an SES framework that may incorporate consideration of the impact of loss of land previously used for subsistence agriculture (and the associated famine), biodiversity loss associated with mono-crops, etc. Conversely, the STS framework might offer insight into how the dynamics of the socio-technical system led these social-ecological impacts to be ignored. In short, both approaches offer complementary insights onto dimensions of the same phenomena. Accordingly, there is an infant body of work examining linked socio-ecological-technical system (SETS).

These frameworks have been relatively little applied to regional transitions, which provides an opportunity for this project to make an exciting theoretical contribution, examining spatial factors that affect transformative capacity in each case, as well as those pertaining to the type of transition being effectuated (which systems are being targeted by the decarbonisation effort).

As discussed by Geels (2011), sustainability transformations (SES) or transitions to sustainability (STS) may be considered a special case of transition for a number of reasons:

1. They are directional and purposive. They entail political leadership, and the articulation of visions and goals. Additionally, private actors may have limited incentives to address sustainability transitions because the goal is related to a collective good. They are also inherently conflict-laden, with necessary and legitimate debate over what sustainability means for whom.
2. Sustainability transitions doesn't necessarily offer obvious user benefits within the present paradigm. They may therefore require changes in economic frame conditions, which implies power struggles against incumbentsand vested interests.
3. They address large socio-technical systems, which are characterised by large firms. These can inhibit the emergence and breakthrough of (technical and social) environmental innovations, or their involvement might accelerate their breakthrough if they support these innovations with their complementary assets and resources.

In any case, the core analytical puzzle, as stated by Geels, "is to understand how environmental innovations emerge and how these can replace, transform or reconfigure existing systems".

### 1.3. Component synthetic description

- **Component Lead partner:** IOER
- **Overall approach:** Transformative Capacity
- **Domain of enquiry:** The component investigates the transformative capacity available in a case study region, focusing on the respective regional economic development system involved in shaping its decarbonisation pathway.
- **Theory:** Sustainability Transitions Research – Social-Ecological Systems (SES), Sociotechnical Systems (STS), and Geography of Transitions.
- **Primary method:** Stakeholder analysis; in-depth interviews
- **Secondary methods:** Focus groups
- **Case diversification:** This component can apply to all cases, with potential for tailoring it to concentrate on factors that may be more relevant to regions at different stages in the transition process (see Dynamics and Patterns).
- **Research area definition:** The unit of analysis is the regional economic development system, insofar as this is concerned with decarbonisation / clean energy transition. This may extend geographically across territory, place, scale and networks, but will pertain to the region as defined by decarbonisation actors/policies.

# 2. Factors, Dynamics and Patterns

## 2.1. Overview

This report identifies, based on Wolfram's (2016, 2018, 2019) Transformative Capacity framework, the factors that are considered crucial for the transformation of a system, be that social-ecological or socio-technical, or indeed coupled. Transformation has been theorised differently, but complementarily, in the two bodies of literature addressed here. To arrive at these factors, we consider the ***dynamics*** which are held to determine change and stability in SES and STS. These are the **Adaptive Cycle (D01)** for SES and the **Multi-level Perspective (MLP) (D02)** on socio-technical transitions for STS. We then identify ***patterns*** that can be seen to emerge from these dynamics. In SES, these relate either to the system remaining within a stability domain (or regime), or falling out of it and transforming into another system. These are alternatively conceptualised as **Resilience (P01)** and **Transformation (P02)**. Both resilience and transformation of systems may be desirable or undesirable, intended or unintended, purposive or emergent, and this is addressed within each pattern as "perverse resilience" (or "lock-in") and "emergent transformation" as opposed to "purposive transformation". In STS several different kinds of pattern can be derived, depending on the framework used. These are addressed under the rubric **Transition Pathways (P03)**. The **Transformative Capacity (F01–F10)** framework considers what systemic attributes, ***factors***, are necessary for attempts to intervene in a system to actually contribute to its eventual transformation.

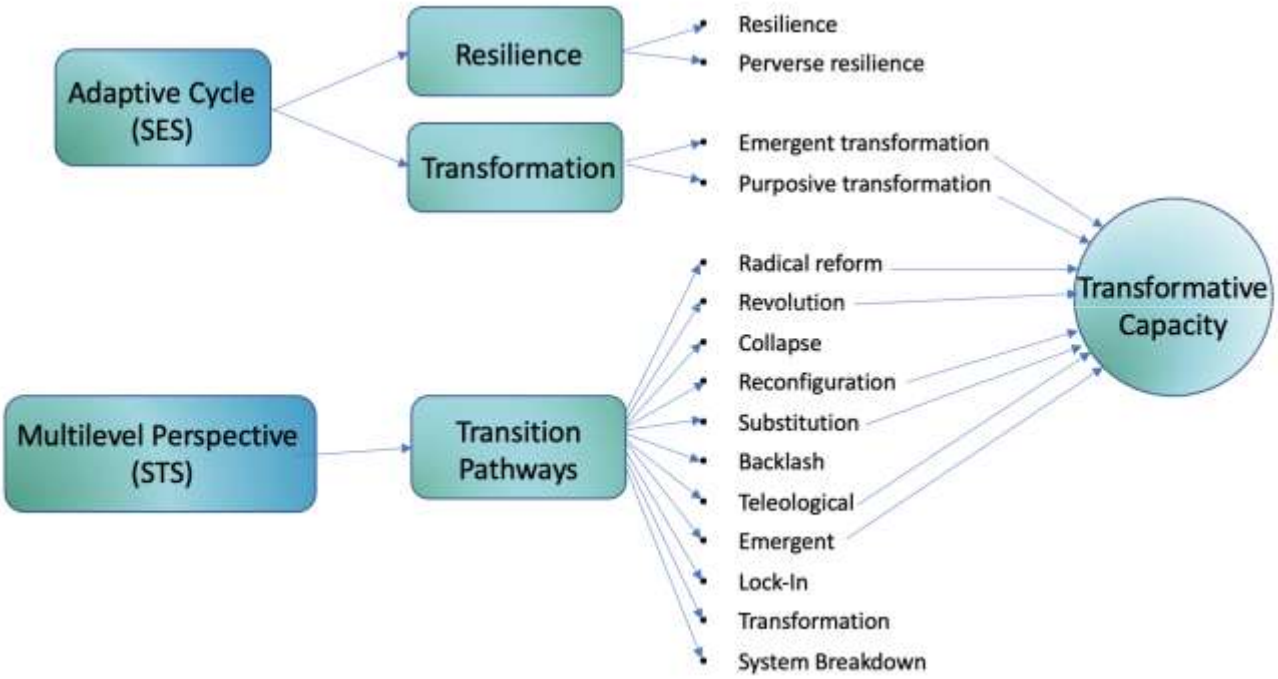


**Figure 1. Dynamics > Patterns > Factors**

## 2.2. Factors

Transformative capacity is defined here as “the collective ability of the stakeholders involved in urban development to conceive of, prepare for, initiate and perform path-deviant change towards sustainability within and across multiple complex systems” (Wolfram 2016: 126) that constitute the regional economic development and decarbonisation environment to which they belong. Factors F01–F03 refer to agency and interaction forms, F04–F08 identify core development processes, and F09–F10 represent relational dimensions that affect all other components.

Transformative Capacity is strongly influenced by the governance of the regional decarbonisation/clean energy transitions in question. There are three governance components that are critical to the ability of a regional development apparatus to foster transformability of a system: the inclusiveness and multiformness of governance arrangements(F01); poly-centric and socially embedded transformative leadership (F02); and the empowerment and autonomy of relevant communities of practice(F03). These elements are preconditions for the transformability of a system: there needs to be connectivity and responsiveness built into governance, effective leadership able to bring people together around a vision, and actors empowered to experiment and innovate.These three attributes must be developed by stakeholders in processes to enhance their transformative potential, including enhancing understanding of the systems of which they are a part(F04), engaging in participatory visioning and alternative design scenarios(F05), experimenting with novel solutions to social needs(F06), and ensuring that these innovations can be embedded(F07). Ideally, this can be seen as a learning loop, where system understanding feeds into sustainability visioning, feeds into experimentation, feeds into embedding and better system understanding, but it can also be a lot messier. These need to be fed back into governance, though, by social learning (F08), and effective involvement of actors at different scales (F09) and levels of agency (F10).

For transformative capacity, governance must create contexts for diverse forms of learning, visioning, and experimentation with the possibility that all this actually feeds back into governance and is taken up. Considering the lock-ins presented by, e.g., governance cultures, economic interests, mind-sets, etc., in many contexts, the actual implementation of transformation will mean “moving beyond a focus on capacities alone to highlight factors such as willingness to transform. The latter is an important factor in change processes taking into account both the resistance that emerges during change processes and the co-optation of transformative ideas or initiatives by powerful actors that can occur” (Reyers et al. 2018, citing Boonstra et al. 2016 and Avelino 2017).


**Figure 2. Transformative Capacity Factors (Source: Wolfram 2016)**

### *2.2.1. Inclusive and multiform governance*

- **Code:** C5-F01
- **Type:** Factor
- **Factor Description:**

Governance is key to transformative capacity. Diversified, flexible, and robust governance structures are necessary for establishing the legitimacy, trust, knowledge, and political leverage needed for transformations (Wolfram 2016: 126). This factor can be broken down into three critical sub-factors:

1. Wide participation and active inclusion of stakeholders from all sectors.
2. Diversity of governance modes and actor networks (de-/centralised, formal/informal, multi-level, etc.).
3. Sustained and effective intermediary organisations and individuals between sectors and domains (hybridisation).

- **Examples/Indicators:**

**C5-F01.1 Participation and Inclusiveness**

- Citizens and civil society organisations, as well as private businesses and their representations, participate directly in the deliberation of actions with state actors (government and administration).
- Formerly excluded stakeholders are involved actively and supported to enable their contribution.

**C5-F01.2 Diverse governance modes and network forms**

- There is diversity of formal and informal actor networks and governance modes.
- There is diversity of centralised and decentralised actor networks and governance modes (top-down/bottom-up; hierarchy/market/negotiation).
- Governance helps to build social capital (trusted actor relations).
- Governance helps to build political capital (mobilisation and support).
- Governance addresses multi-level and cross-scale implications.
- Overall actor network density (number of ties between actors involved) and cohesion (alignment of their interests) are balanced and not extreme (very high/low).

**C5-F01.3 Sustained intermediaries and hybridisation**

- There are intermediaries positioned between societal stakeholders that bridge relevant gaps amid sectors (public, private and civil society), action domains (e.g., energy/transport/land use), and/or spatial scales.
- Intermediaries have a stable financial and organisational basis.
- There are key individuals acting as boundary spanners or knowledge brokers between sectors, action domains and scales.
- Intermediaries effectively align different actor interests and help create a shared discourse.

- **Type of region:** This can apply to all regions where governance/regional economic development structures are involved in a decarbonisation/clean energy transition with cross-sectoral scope (i.e., implying interventions outside of the high-carbon sector). The framework is not applicable to regions where decarbonisation is the concern only of sectoral actors (e.g., high-carbon industry).
- **Regions:** All
- **Gender-sensitive:** Yes, insofar as governance, and participation frameworks, may reinforce gender-based social roles, divisions of labour, and political participation.Willingness and capability for participation depends on gender, age, and education, inter alia. Furthermore, contrary to institutionalised participation, women and younger people participate more often in non-

institutionalised settings than men and older people. Education however remains an important source of inequality in participation. For non-institutionalised participation, political awareness plays an important role, and is also influenced by gender. Furthermore, social capital proves to be important, given that generalised trust, union membership and informal networks all positively contribute to non-institutionalised participation (Hooghe 2013).

- **Primary Method:** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Method(s):** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Internal relations (explained):** All factors are related to all others in this integrative framework.
- **Possible overlap:** Socio-political component: stakeholder analysis
- **Sources:**
  - ***Key reference:*** Wolfram, M. (2016). Conceptualizing urban transformative capacity: A framework for research and policy. Cities, 51, 121–130.
  - Eade, D. (1997). Capacity building: An approach to people-centred development. Development Guidelines.
  - Healey, P. (1998). Building institutional capacity through collaborative approaches to urban planning. Environment &Planning A, 30, 1531–1546.
  - Innes, J., &Booher, D. (2003). The impact of collaborative planning on governance capacity. IURD Working Paper Series. Baltimore. Institute of Urban &Regional Development.
  - Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. Global Environmental Change, 19, 354–365.
  - Ubels, J., Acquaye-Baddoo, N.-A., &Fowler, A. (Eds.). (2010). Capacity development in practice. London: Earthscan.
  - Rijke et al. (2012). Fit-for-purpose governance: A framework to make adaptive governance operational. Environmental Science &Policy, 22, 73–84.
- **Other comments:** These factors have been operationalised in research by CastánBroto et al. (2019) into a simplified set of indicators for assessing sustainability *projects* from documentary analysis. These may be a useful starting point for operationalisation, but should be developed for more complex regional governance *systems*, by identification and assessment of relevant governance structures and formats.

| **C1. Inclusive, multiform governance** | | |
|---|---|---|
| **Sub-Factor** | **Satisfied when evidence found that…** | **Example:** |
| C1.1 Participation/inclusiveness | Citizens and/or civil society organisations participate directly in planning and/or decision-making processes. | • Active participation of citizens and/or civil society organisations in decision-making processes through mechanisms such as **participatory or collaborative planning**, **public consultation**, or **initiatives led by communities** |
| C1.2 Diverse governance modes/networks | Different and various stakeholders work together and build connections between sectors in different manners. | • A **variety of actors involved** throughout the process.<br>• Institutional development and capacity building in relation to **building social capital**, for example, by creating **relations of trust** between stakeholders or **formal communication channels** for marginalised groups that could facilitate future collaboration. |
| C1.3 Sustained intermediaries and hybridisation | An intermediary is positioned between the stakeholders of a project. | • **Involvement of external actor** (individual or organisation), such as an **NGO or a consultant** that is not itself a direct stakeholder (such as a local inhabitant, or a government representative).<br>• Measures to facilitate **sustained involvement of the intermediaries** such as **independent streams of funding** or **integration into project governance structures**. |

### *2.2.2. Transformative leadership (in the public, private and civil society sectors)*

- **Code:** C5-F02

- **Type:** Factor
- **Factor Description:**

Transformations demand particular forms and attributes of leadership that enhance individuals' vital role as change agents. In particular, leadership needs to be polycentric and socially embedded, arising not only from political elites, but also from many other issue-driven and/or place-based communities in society. Beyond commitment, its contribution should especially imply the translation between discourses (across sectors, domains, scales) and the articulation of new visions and discourses embracing sustainability, as well as various personal abilities that leverage collective energies and enable social learning.

- **Examples/Indicators:**
    - There is place-based and/or issue-driven leadership in various sectors, oriented at systemic change for sustainability.
    - Leadership embraces joint problem-solving, shared decision-making and open processes.
    - Leadership articulates visions, emphasizes values and inspires enthusiasm.
    - Leadership feeds local issues into regional/national/global arenas and processes.
    - Leadership translates global/national/regional issues into local arenas and processes.
    - There is political leadership and commitment to systemic change for sustainability.
- **Type of region:** This can apply to all regions where governance/regional economic development structures are involved in a decarbonisation/clean energy transition with cross-sectoral scope (i.e., implying interventions outside of the high-carbon sector). The framework is not applicable to regions where decarbonisation is the concern only of sectoral actors (e.g., high-carbon industry).
- **Regions:** All
- **Gender-sensitive:** Yes, insofar as gender-based social roles, divisions of labour, and political participation may influence the status (and emergence) of women as leaders.Related theories which are closely connected to transformational leadership are critical theories of race and gender, cultural and social reproduction, and leadership for social justice. The processes which take place are deconstruction and reconstruction of social/cultural knowledge frameworks that generate inequity, acknowledgement of power and privilege and the dialectic between the individual and the social (Shields 2010).
- **Primary Method:** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Method(s):** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Internal relations (explained):** All factors are related to all others in this integrative framework.
- **Possible overlap:** Socio-political component: stakeholder analysis.
- **Sources:**

***Key reference:*** Wolfram, M. (2016). Conceptualizing urban transformative capacity: A framework for research and policy. Cities, 51, 121–130.

Olsson, P., Bodin, Ö., &Folke, C. (2010). Building transformative capacity for ecosystem stewardship in social–ecological systems. In D. Armitage, &R. Plummer (Eds.), Adaptive Capacity and Environmental Governance (pp. 263–285). Springer.

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Bos, J.J., &Brown, R.R. (2014). Assessing organisational capacity for transition policy programs. Technological Forecasting and Social Change, 86, 188–206.

Ardoin, N.M., Gould, R.K., Kelsey, E., &Fielding-Singh, P. (2015). Collaborative and transformational leadership in the environmental realm. Journal of Environmental Policy &Planning, 17, 360–380.
Shields, C. M. (2010). Transformative Leadership: Working for Equity in Diverse Contexts. *Educational Administration Quarterly*, 46(4): 558–589.

- **Other comments:** These factors have been operationalised in research by CastánBroto et al. (2019) into a simplified set of indicators for assessing sustainability *projects* from documentary analysis, as follows. This may be useful for operationalisation, but should be developed for more complex regional governance systems, by identification and assessment of relevant governance structures and formats.

| **C2. Transformative leadership** | |
|---|---|
| **Satisfied when evidence found that…** | **Example:** |
| Leadership acts as a driving collaborative force in an initiative | • Leadership linking local action with global arenas and processes<br>• Certain actors championing a case and inspiring enthusiasm through articulation of shared values or visions. |

### *2.2.3. Empowered and autonomous communities of practice*

- **Code:** C5-F03
- **Type:** Factor
- **Factor Description:**

Meeting social needs is a cornerstone of both capacity development and sustainability. This reflects an ethical dimension (intra- and inter- generational equity), as well as the recognition of human agency as the key to balance long-term ecosystem health and economic welfare. Social learning networks formed through the shared experience of place and/or wider joint concerns are decisive for identifying and articulating unmet social needs, and formulating responses. Therefore, such 'communities of practice' (Wenger, 2000) require association, coalition forming, access to resources and conditions of autonomy.

- **Examples/Indicators:**

1. **Addressing social needs and motives:**
    - Communities of practice (CoP) genuinely articulate social needs.
    - Social needs are analysed and deficits in meeting them are identified.
    - Deficits in meeting social needs inform action priorities in public policy.
2. **Community empowerment and autonomy:**
    - Conditions of citizen powerlessness and disempowerment are identified.
    - Stakeholder association and formation of CoP's is actively supported.
    - CoP's have access to resources they require to meet social needs (information, time, space, skills, tools, social networks, social organization, financing).
    - Actions are taken to enhance feelings of self-efficacy and self-determination of CoP.
    - The level of CoP autonomy is effectively being raised.

- **Type of region:** This can apply to all regions where governance/regional economic development structures are involved in a decarbonisation/clean energy transition with cross-sectoral scope (i.e., implying interventions outside of the high-carbon sector). The framework is not applicable to regions where decarbonisation is the concern only of sectoral actors (e.g., high-carbon industry).
- **Regions:** All

- **Gender-sensitive:** Yes, insofar as participation on communities of practice may be influenced by prevalent gender-based social roles, divisions of labour, and norms of political participation (Eames &Egmose 2011).
- **Primary Method:** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Method(s):** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Internal relations (explained):** All factors are related to all others in this integrative framework.
- **Possible overlap:** Socio-political component: stakeholder analysis
- **Sources:**

***Key reference:*** Wolfram, M. (2016). Conceptualizing urban transformative capacity: A framework for research and policy. Cities, 51, 121–130.
Friedmann, J. (1992). Empowerment: The politics of alternative development. Cambridge, MA: Blackwell.
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Wittmayer, J., Roorda, C., &Van Steenbergen, F. (2014). Governing urban sustainability transitions — Inspiring examples. Rotterdam: Dutch Research Institute for Transitions.
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Ubels, J., Acquaye-Baddoo, N. -A., &Fowler, A. (Eds.). (2010). Capacity development in practice. London. Washington, DC: Earthscan.
Moulaert, F., MacCallum, D., &Hillier, J. (2013). Social innovation: intuition, precept, concept, theory and practice. In: The international handbook on social innovation collective action. Social Learning and Transdisciplinary Research. Cheltenham: Edward Elgar, 13–24.

- **Other comments:** These factors have been operationalised in research by CastánBroto et al. (2019) into a simplified set of indicators for assessing sustainability projects from documentary analysis, as follows. This may be useful for operationalisation, but should be developed for more complex regional governance systems, by identification and assessment of relevant governance structures and formats.

| **C3. Empowered communities of practice** | | |
|---|---|---|
| **Sub-Factor** | **Satisfied when evidence found that…** | **Example:** |
| C3.1<br>Social needs | Social needs are either analysed or addressed | • Explicit references to local social agendas, in particular those that addressed vulnerable groups and issues of social marginalisation<br>• Strategies seeking to improve the wellbeing and quality of life of citizens that also pay particular attention to questions of social justice. |
| C3.2<br>Autonomous communities of practice | Different aspects of community empowerment are integrated into the design of the project | • Project design providing citizens/communities not only with new or improved facilities and/or services, but also with new skills, training and abilities, improved access to political processes, greater independence and self-efficacy<br>• Measures or resources to allow direct involvement of communities in decision making processes or independently realise their objectives. |

### *2.2.4. System(s) awareness and memory*

- **Code:** C5-F04
- **Type:** Factor

- **Factor Description:**

Transformative change presupposes awareness and understanding among stakeholders of the system dynamics, path dependencies and obduracies that undermine sustainability (Burch &Robinson, 2007, 309). Collective analysis capabilities and routines thus need to be developed to foreground linkages between cultures, structures and practices in different cross-scale SES and STS. The focus should be on meeting social needs, and creating widely shared system knowledge and memory to explain and anticipate performance, and inform (collective) agency and capacity development processes.

- **Examples/Indicators:**

**Baseline analysis and system(s) awareness**

- New knowledge of systemic relations between ways of thinking (cultures), organizing (structures) and doing (practices) is actively developed to understand deficits in meeting social needs.
- Governance structures, institutions and stakeholder conflicts are subject to dedicated analysis.
- Analysis aims to move from status description towards a systemic explanation, and ultimately anticipation, of (non-)change dynamics (barriers/drivers).
- All knowledge about urban systems is open source and widely shared, helping to create collective self-awareness and memory.
- Strategic knowledge management is carried out to enable transfers between different forms of knowledge (implicit/explicit; simple/complex; systemic/sectoral) and temporalities of knowledge (past, present, future).

**Recognition of path dependencies**

- Stakeholders explicitly recognise different degrees of obduracy/changeability within current systems (e.g., concerning institutions, regulations, infrastructures, built environs, routines, values).

- **Type of region:** This can apply to all regions where governance/regional economic development structures are involved in a decarbonisation/clean energy transition with cross-sectoral scope (i.e., implying interventions outside of the high-carbon sector). The framework is not applicable to regions where decarbonisation is the concern only of sectoral actors (e.g., high-carbon industry).
- **Regions:** All
- **Gender-sensitive:** No, although gender awareness might be a useful aspect of system(s) awareness!
- **Primary Method:** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Method(s):** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Internal relations (explained):** All factors are related to all others in this integrative framework.
- **Possible overlap:**
- **Sources:**

***Key reference:*** Wolfram, M. (2016). Conceptualizing urban transformative capacity: A framework for research and policy. Cities, 51, 121–130.

Garud, R., &Nayyar, P.R. (1994). Transformative capacity: Continual structuring by intertemporal technology transfer. Strategic Management Journal, 15, 365–385.

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Burch, S., &Robinson, J. (2007). A framework for explaining the links between capacity and action in response to global climate change. Climate Policy, 7, 304–316.

Halpin, D., &Daugbjerg, C. (2008). Associative deadlocks and transformative capacity: Engaging in Australian organic farm industry development. Australian Journal of Political Science, 43, 189–206.

Olsson, P., Bodin, Ö., &Folke, C. (2010). Building transformative capacity for ecosystem stewardship in social–ecological systems. In D. Armitage, &R. Plummer (Eds.), Adaptive Capacity and Environmental Governance

Ferguson, B.C., Brown, R.R., &Deletic, A. (2013). Diagnosing transformative change in urban water systems: Theories and frameworks. Global Environmental Change, 23, 264–280.

- **Other comments:** These factors have been operationalised in research by CastánBroto et al. (2019) into a simplified set of indicators for assessing sustainability projects from documentary analysis, as follows. This may be useful for operationalisation, but should be developed for more complex regional governance systems, by identification and assessment of relevant governance structures and formats.

| **C4. System awareness** | | |
|---|---|---|
| **Sub-Factor** | **Satisfied when evidence found that…** | **Example:** |
| C4.1<br>Baseline analysis and system(s) awareness | Agendas aiming to tackle sustainability challenges after deliberate analysis of relevant systems (e.g., energy production, industrial processes) | • Actively analysing existing governance structures, institutional landscapes and natural resource conditions and efforts to use this knowledge to plan interventions.<br>• Strategic knowledge management processes carried out to understand current conditions. |
| C4.2<br>Recognition of pathdependencies | Explicitly tackling systemic barriers to change | • Recognising systemic barriers (including regulations, physical barriers, but also cultural values, such as perceptions or established routines) that need to be overcome for the project to become viable or successful.<br>• Explicit strategies to overcome these path dependencies. |

### *2.2.5. Sustainability foresight*

- **Code:** C5-F05
- **Type:** Factor
- **Factor Description:**

Future pathways linked to sustainability raise diverse normative questions and feasibility issues that require clarification and negotiation among urban stakeholders in order to create actionable policies, plans and projects. Beyond a system baseline and account for critical obduracies (C4), target knowledge and transformational knowledge thus have to be developed through transdisciplinary co-production (Loeber, 2007; Rauschmayer et al., 2015). To provide orientation at different agency levels (C1–3), foresight should create a collective vision of radical departure from the current path, as well as alternative scenarios based on system thinking.

- **Examples/Indicators:**

**Diversity and transdisciplinary co-production of knowledge**

- Knowledge about future un−/desirable developments is co-produced by actively involving diverse stakeholders from across sectors, action domains and scales - experts and laymen.
- Science stakeholders are directly involved in knowledge co-production, including both technical and non-technical disciplines.

**Collective vision for radical sustainability changes:**

- Long-term change is conceived of as a ‘radical’ departure from the current state and development path of multiple SES and STS.

- There is an explicit future vision, widely shared among stakeholders, reflecting the social needs identified and the existing diversity of values.
- The vision has a strong motivating effect on stakeholders to contribute to its achievement.
- The vision provides orientation for a wide range of strategies, programs and projects, allowing for flexibility and leaving options open.

**Alternative scenarios and future pathways:**

- Scenarios for future regional development are created that reflect co-evolutionary processes (mutual shaping of social, ecological, economic and technological dimensions).
- Different scenarios illustrate alternative future pathways resulting from stakeholder choices and uncertainties.
- Scenarios clarify options for actions, their preconditions and implications for the relevant stakeholders, specifying objectives and critical milestones (thresholds).

- **Type of region:** This can apply to all regions where governance/regional economic development structures are involved in a decarbonisation/clean energy transition with cross-sectoral scope (i.e., implying interventions outside of the high-carbon sector). The framework is not applicable to regions where decarbonisation is the concern only of sectoral actors (e.g., high-carbon industry).
- **Regions:** All
- **Gender-sensitive:** Yes. Following, Bauer&Pregernig(2013), domination comes firstly through the indirect exclusion of certain groups: When assessed in purely quantitative terms, the answer to the question of who has avoice in future-thinking would be: 'the middle-aged male expert' and 'the middle-agedmale stakeholder'.This biased representation results from the domination of the cognitiveand the constructive rationale, under which the selection of participants is stronglydriven by a person's institutional and professional background. Thiscauses scientific experts, interest group representatives, business leaders and administrativedecision-makers to be privileged over average citizens and consequently mirrors theuneven representation of men and women and younger and older people in the respective technological or political-administrative areas. When well done, the sustainability foresight can open an opportunity for shared deliberation, "moving the discussion on from immediate concerns and challenges, and allowing a sharedexploration of the hopes and aspirations of the community participants for a more sustainable future" (Eames &Egmose 2011) and include deliberate and thoughtful consideration of how gender plays a role in shaping this future.
- **Primary Method:** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Method(s):** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Internal relations (explained):** All factors are related to all others in this integrative framework.
- **Possible overlap:**
- **Sources:**

***Key reference:*** Wolfram, M. (2016). Conceptualizing urban transformative capacity: A framework for research and policy. Cities, 51, 121–130.

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- **Other comments:** These factors have been operationalised in research by CastánBroto et al. (2019) into a simplified set of indicators for assessing sustainability projects from documentary analysis, as follows. This may be useful for operationalisation, but should be developed for more complex regional governance systems, by identification and assessment of relevant governance structures and formats.

| **C5. Sustainability foresight** | | |
|---|---|---|
| **Sub-Factor** | **Satisfied when evidence found that…** | **Example:** |
| C5.1 Co-production of knowledge | Involvement of various and multiple stakeholders in knowledge production processes. | • Involvement of diverse groups such as experts, external stakeholders, civil society and other government authorities in production of knowledge related to the targeted sustainability issues. |
| C5.2 Collective vision for change | An explicit future vision shared amongstakeholders as a means for motivating partners and fostering commitments. | • Visions that are at once (1) explicitly formulated, (2) aiming for radical change, and (3) supported by a wide range of stakeholders.<br>• *This should not include initiatives based on visions that are not radical (e.g., incremental agendas such as air pollution protection) or that appear to be endorsed by few actors only (such as political elites).* |
| C5.3 Alternative scenarios, future pathways | Comparative scenarios that evaluate the mutual shaping of social, ecological, economic and technological dimensions. | • Evaluation of multiple alternative visions or pathways for change.<br>• This includes, for example, envisioning exercises that take into account different possible development outcomes associated with different policies or environmental conditions. |

### *2.2.6. Diverse community-based experimentation with disruptive solutions*

- **Code:** C5-F06
- **Type:** Factor
- **Factor Description:**

Practical experimentation offers a crucial mechanism to develop transformative knowledge and catalyse social learning. Its systemic effects can be enhanced if experiments are guided by a collective vision (ST–05), embedded by place-based and/or issue-driven communities of practice (ST–03), and embracing holistic innovation (cultures, structures, practices — ST–04). Most importantly, wider impacts depend on the degree to which such experiments are equally path-deviant, thus seeking to fundamentally rebalance long-term social, ecological and economic development.

- **Examples/Indicators:**

  - Diverse experimentation is undertaken by place-based and/or issue-driven communities of practice.
  - Experiments are guided by a shared vision, and by preferred scenarios/pathways (if available).

- Experiments deal with disruptive urban sustainability solutions, seeking to rebalance economic, social and ecological development.
- Experiments are multi-dimensional, simultaneously addressing innovations in environments, cultures, institutions, governance, markets and technology.

- **Type of region:** This can apply to all regions where governance/regional economic development structures are involved in a decarbonisation/clean energy transition with cross-sectoral scope (i.e., implying interventions outside of the high-carbon sector). The framework is not applicable to regions where decarbonisation is the concern only of sectoral actors (e.g., high-carbon industry).
- **Regions:** All
- **Gender-sensitive:** Yes, insofar as breaking gender-based social roles, divisions of labour, and political participation norms may be part of disruptive experimentation.
- **Primary Method:** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Method(s):** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Internal relations (explained):** All factors are related to all others in this integrative framework.
- **Possible overlap:**
- **Sources:**

  ***Key reference:*** Wolfram, M. (2016). Conceptualizing urban transformative capacity: A framework for research and policy. Cities, 51, 121–130.

  Friedmann, J. (1992). Empowerment: The politics of alternative development. Cambridge, MA: Blackwell.

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  Olsson, P., Bodin, Ö., &Folke, C. (2010). Building transformative capacity for ecosystem stewardship in social–ecological systems. In D. Armitage, &R. Plummer (Eds.), Adap- tive Capacity and Environmental Governance

  Wittmayer, J., Roorda, C., &Van Steenbergen, F. (2014). Governing urban sustainability transitions — Inspiring examples. Rotterdam: Dutch Research Institute for Transitions.

  Rauschmayer, F., Bauler, T., &Schäpke, N. (2015). Towards a thick understanding of sustainability transitions — Linking transition management, capabilities and social practices. Ecological Economics, 109, 211–221.
- **Other comments:** These factors have been operationalised in research by CastánBroto et al. (2019) into a simplified set of indicators for assessing sustainability projects from documentary analysis, as follows. This may be useful for operationalisation, but should be developed for more complex regional governance systems, by identification and assessment of relevant governance structures and formats.

| **C6. Experimentation with disruptive solutions** | |
|---|---|
| **Satisfied when evidence found that…** | **Example:** |
| Deliberate use of experiments or ideas that seek to challenge the existing landscape of established policies, technologies or social practices. | • Active trialling or demonstration of new solutions (i.e. both social practices as well as new technologies) as opposed to plans or intentions to support new solutions).<br>• New solutions were radically different from existing practices or technologies.<br>• *This should not include incremental improvements, such as to improve energy efficiency.* |

### *2.2.7. Innovation embedding and coupling*

- **Code:** C5-F07
- **Type:** Factor

- **Factor Description:**

All components identified in this framework presuppose that stakeholders share and/or enable access to basic resources for the purpose of developing capacity, starting from the people involved and locations for meetings — but increasingly also financial and material resources for practical transformation. The extent to which this is facilitated by gradually removing barriers to innovative practices and embedding them into routines, organizations, plans and especially legal frameworks, is thus a critical capacity factor that needs to carefully attend practicability issues to effectively enable uptake and mainstreaming. It can be further enhanced by coupling different innovations into alternative pathways, as well as by practical approaches to building related actor coalitions (cf. Gottschick, 2013).

- **Examples/Indicators:**

**7.1 Access to resources for capacity development:**

- Stakeholders share and/or enable access to basic resources for transformative capacity development (ST01–06) incl. human-, knowledge-, time-, financial-, technical- and organizational resources).

**7.2 Planning and mainstreaming transformative action:**

- Options for innovation arising from foresight and/or experiments are integrated with possible actor coalitions to form 'systemic alternatives' (combinations of actors, institutions, resources, etc.)
- Practical approaches for coalition building and decision-making procedures that enable innovation embedding are developed systematically
- Stakeholder organizations, plans and/or programs are adjusted to remove innovation barriers and support transformative actions
- Priority transformative actions are further specified through concrete work plans (management, resources, timing)).

**7.3 Reflexive and supportive regulatory frameworks:**

- Pertinent regulations are aligned with the vision and adjusted to remove innovation barriers and support transformative actions
- Pertinent regulations leave room for alternative solutions and context-specific interpretation and implementation
- Pertinent regulations enable to use wider resource streams for transformative action (financial, human, technical, organizational).

- **Type of region:** This can apply to all regions where governance/regional economic development structures are involved in a decarbonisation/clean energy transition with cross-sectoral scope (i.e., implying interventions outside of the high-carbon sector). The framework is not applicable to regions where decarbonisation is the concern only of sectoral actors (e.g., high-carbon industry).
- **Regions:** All
- **Gender-sensitive:** Yes, insofar as access to resources may reinforce gender-based social roles, divisions of labour, and participation norms.
- **Primary Method:** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Method(s):** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Internal relations (explained):** All factors are related to all others in this integrative framework.
- **Possible overlap:**
- **Sources:**

***Key reference:*** Wolfram, M. (2016). Conceptualizing urban transformative capacity: A framework for research and policy. Cities, 51, 121–130.

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- **Other comments:** These factors have been operationalised in research by CastánBroto et al. (2019) into a simplified set of indicators for assessing sustainability projects from documentary analysis, as follows. This may be useful for operationalisation, but should be developed for more complex regional governance systems, by identification and assessment of relevant governance structures and formats.

| **C7. Innovation embedding** | | |
|---|---|---|
| **Sub-Factor** | **Satisfied when evidence found that…** | **Example:** |
| C7.1 Resources for capacity development | Project stakeholders sharing resources for capacity developmentoutside the project to disseminate and multiply results. | • Sharing of lessons learnt, knowledge and expertise through events, workshops, publications (printed or online) or offering direct advice and support to groups that could benefit from the expertise.<br>• Provision of resources for training of individuals or organisations, or partnering up with new organisations and providing funding to share insights gained through the initiative. |
| C7.2 Mainstreaming transformative action | Attempts to generalise the project operation or results beyond the initial context of application. | • Replicating or applying the project itself or various processes, methods, components or solutions in different settings and locations<br>• Embedding changes in institutional settings to allow for the continuity of the project and lessons learnt as 'the new norm'. |
| C7.3 Regulatory frameworks | New regulation was established as a result of the project or as part of the project activities. | • Projects leading to lasting change through embedment in legal, regulatory and policy frameworks.<br>• For example, this might include cases where initiatives led by communities or civil society cause local authorities to alter policy or regulation, or where local regulation is absorbed on a national level. |

### *2.2.8. Reflexivity and social learning*

- **Code:** C5-F08
- **Type:** Factor
- **Factor Description:**

To enable positive feedback loops, learning must be linked to all actions for change. This implies to develop skills for applying assessment methods (monitoring, evaluation), to create diverse formal and informal reflexivity formats that critically question progress towards the vision, and to systematically manage new transformational knowledge created. To increase the depth of social learning, reflexivity thus needs to address all agency levels and relate to all core development processes (ST04–07), as well as to leadership, governance and community empowerment (ST01–03).

- **Examples/Indicators:**
    - Reflexive monitoring is carried out on all dimensions of transformative capacity development (ST01-07).

- Participants in experiments have methodical and practical skills for enabling reflexivity (monitoring, assessment, evaluation).
- Wider stakeholder and leadership reflexivity is enabled through diverse formal and informal interaction formats, providing room for critically questioning progress towards the vision.
- Practical know-how for initiating and performing radical change for sustainability (i.e., transformational knowledge) is managed systematically.

- **Type of region:** This can apply to all regions where governance/regional economic development structures are involved in a decarbonisation/clean energy transition with cross-sectoral scope (i.e., implying interventions outside of the high-carbon sector). The framework is not applicable to regions where decarbonisation is the concern only of sectoral actors (e.g., high-carbon industry).
- **Regions:** All
- **Gender-sensitive:** Yes, insofar as reflexivity and social learning might encourage reflection on gender-based social roles, divisions of labour, and political participation norms.
- **Primary Method:** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Method(s):** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Internal relations (explained):** All factors are related to all others in this integrative framework.
- **Possible overlap:**
- **Sources:**

  ***Key reference:*** Wolfram, M. (2016). Conceptualizing urban transformative capacity: A framework for research and policy. Cities, 51, 121–130.

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  Sotarauta, M., Horlings, I., &Liddle, J. (Eds.). (2012). Leadership and change in sustainable regional development. New York: Routledge.

  Wittmayer, J., Roorda, C., &Van Steenbergen, F. (2014). Governing urban sustainability transitions — Inspiring examples. Rotterdam: Dutch Research Institute for Transitions.
- **Other comments:** These factors have been operationalised in research by CastánBroto et al. (2019) into a simplified set of indicators for assessing sustainability projects from documentary analysis, as follows. This may be useful for operationalisation, but should be developed for more complex regional governance systems, by identification and assessment of relevant governance structures and formats.

| **C8. Reflexivity and social learning** | |
|---|---|
| **Satisfied when evidence found that…** | **Example:** |
| Stakeholders reflect on learning and capacity building processes. | • Procedures for recording, evaluating and assessing procedures.<br>• Reflecting on how the project unfolded as well as if and how the project visions were met. This includes references to open discussions and critical dialogue on project development as well formal methods for reporting and monitoring. |

### *2.2.9. Working across human agency levels*

- **Code:** C5-F09
- **Type:** Factor
- **Factor Description:**

Capacity development needs to occur at different agency levels simultaneously, addressing individuals, households, groups, organizations, networks as well as society at large. This should be increasingly reflected in all the above components (ST01–08), including also the individual agency of transformative leadership with a view to its social embeddedness. Working across agency levels accounts for the different (cognitive, psychological, social, ecological, economic, institutional, etc.) requirements and motives at each level, thus supporting their respective contribution to transformation.

- **Examples/Indicators:**
  - Capacity development (ST01-08) addresses multiple levels of agency in the public, private and civil society sectors, including individuals,households, social groups, organizations, networks (of individuals, groups, etc.) and society.
- **Type of region:** This can apply to all regions where governance/regional economic development structures are involved in a decarbonisation/clean energy transition with cross-sectoral scope (i.e., implying interventions outside of the high-carbon sector). The framework is not applicable to regions where decarbonisation is the concern only of sectoral actors (e.g., high-carbon industry).
- **Regions:** All
- **Gender-sensitive:** Yes, insofar as working across human agency levels may be affected by gender-based social roles, divisions of labour, and (political) participation norms.
- **Primary Method:** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Method(s):** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Internal relations (explained):** All factors are related to all others in this integrative framework.
- **Possible overlap:**
- **Sources:**

***Key reference:*** Wolfram, M. (2016). Conceptualizing urban transformative capacity: A framework for research and policy. Cities, 51, 121–130.

Friedmann, J. (1992). Empowerment: The politics of alternative development. Cambridge, MA: Blackwell.

Ubels, J., Acquaye-Baddoo, N. -A., &Fowler, A. (Eds.). (2010). Capacity development in practice. London. Washington, DC: Earthscan.

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- **Other comments:** These factors have been operationalised in research by CastánBroto et al. (2019) into a simplified set of indicators for assessing sustainability projects from documentary analysis, as follows. This may be useful for operationalisation, but should be developed for more complex regional governance systems, by identification and assessment of relevant governance structures and formats.

| **C9. Working across human agency levels** | |
|---|---|
| **Satisfied when evidence found that…** | **Example:** |
| Project activities contribute to capacity development across human agency levels. | • Capacity building activities occurring across agency levels including individuals, households, social groups, organisations, networks and society. |

### *2.2.10. Working across political-administrative levels and geographical scales*

- **Code:** C5-F10
- **Type:** Factor
- **Factor Description:**

Given the cross-scale and multi-level nature of sustainability transitions (Coenen&Truffer, 2012), urban transformative capacity development should consciously incorporate this understanding into all the components discussed above (ST01–09). While particular emphasis is put on the local scale and place (ST-03, ST-06), implications of interactions between scales (e.g., material flow) and administrative boundaries (e.g., regions, metropolitan areas, national policy) for decarbonisation and sustainability must be considered in terms of the questions raised and the stakeholders involved, thus increasingly enabling systemic reflection and responses.

- **Examples/Indicators:**
    - Capacity development (ST01-08) reflects interactions between political-administrative levels and between geographical scales in terms of the topics addressed and stakeholders involved, including urban territories (cities and metropolitan areas), regional territories (e.g., counties, provinces), national territories, inter- and transnational spaces.
- **Type of region:** This can apply to all regions where governance/regional economic development structures are involved in a decarbonisation/clean energy transition with cross-sectoral scope (i.e., implying interventions outside of the high-carbon sector). The framework is not applicable to regions where decarbonisation is the concern only of sectoral actors (e.g., high-carbon industry).
- **Regions:** All
- **Gender-sensitive:** Yes, insofar as working across political-administrative and geographical scales may be affected by gender-based social roles, divisions of labour, and (political) participation norms.
- **Primary Method:** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Method(s):** Stakeholder analysis in conjunction with self-assessment interviews and researcher's assessment.
- **Internal relations (explained):** All factors are related to all others in this integrative framework.
- **Possible overlap:**
- **Sources:**

***Key reference:*** Wolfram, M. (2016). Conceptualizing urban transformative capacity: A framework for research and policy. Cities, 51, 121–130.

Innes, J., &Booher, D. (2003). The impact of collaborative planning on governance capacity. IURD Working Paper Series. Baltimore. Institute of Urban &Regional Development.

Ubels, J., Acquaye-Baddoo, N.-A., &Fowler, A. (Eds.). (2010). Capacity development in practice. London. Washington, DC: Earthscan.

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Olsson, P., Bodin, Ö., &Folke, C. (2010). Building transformative capacity for ecosystem stewardship in social–ecological systems. In D. Armitage, &R. Plummer (Eds.), Adaptive Capacity and Environmental Governance.

- **Other comments:** These factors have been operationalised in research by CastánBroto et al. (2019) into a simplified set of indicators for assessing sustainability projects from documentary analysis, as follows. This may be useful for operationalisation, but should be developed for more complex regional governance systems, by identification and assessment of relevant governance structures and formats.

| **C10. Working across levels and scales** | |
|---|---|
| **Satisfied when evidence found that…** | **Example:** |

| | |
|---|---|
| Project activities contributing to building capacity across geographical or political–administrative levels. | • We considered whether initiatives involved capacity building at different levels of government, including local, municipal, regional, national and supranational. |

## 2.3. Dynamics

Dynamics here refers both to the processes which produce change and stability in evolving complex adaptive systems. These are conceptualised through the panarchy model of adaptive cycles in SES and the multi-level perspective (MLP) on socio-technical transitions in STS. These provide complementary lenses on change dynamics, which can be useful for identifying where regions are located in these evolutionary processes, and the activities and aspects of transformative capacity that may be most appropriate to investigate or enhance at any particular stage.

### *2.3.1. The Adaptive Cycle*

- **Code:** C5-D01
- **Type:** Dynamic
- **Factor Description:**

The adaptive cycle describes endogenously generated dynamics in complex adaptive systems as a result of internal processes of self-organisation and evolution over time. These processes see the system pass sequentially through four states, of growth (*r*), conservation (*K*), collapse (Ω), and renewal (α), each characterised by different levels of system potential (accumulated assets), connectedness (internal structural cohesion), and consequently, resilience (Holling 1986, Gunderson &Holling 2002). It thus provides "an analytical frame for tracking [complex adaptive] systems through sequential stability states and their intervening periods of collapse and reconstruction" (Pelling &Manuel-Navarette 2011).

Applied to ecology, one might see a forest ecosystem passing through these states as it recovers from a fire event (Ω), with the emergence of pioneer species (α) – annuals, grasses, perennials – giving way to intermediate species (*r*) – shrubs, pines, young oak and hickory – over the course of 5 to 150 years, eventually leading to the establishment of a mature forest ecosystem consisting of oak and hickory (*K*), which remains in this state until a subsequent crisis (Ω) drives the system into another such loop.

The panarchy theory posits that systems comprise a nested hierarchy of such patterns and processes at discontinuous scales (continuing with the forest example; needle, crown, patch and stand all represent different systems at discontinuous scales) with dynamics at one scale potentially feeding into processes occurring up and down the scales (Gunderson &Holling 2002). While faster systems may invent, experiment and test, slower levels stabilise and conserve accumulated memory of past, successful experiments. Two inter-scale interactions are important to the framework: "Revolt" occurs when events in fast, small systems overwhelm large, slow ones; and "Remember" occurs when the potential accumulated and stored in the larger, slow levels influences reorganisation of the overall system.

In ecology, it has been argued that this framework is "more than a metaphor", with attempts to operationalise it in relation to thermodynamic properties of ecosystems, and use of discontinuities to identify the state of an ecosystem (Sundstrom &Allen 2019). It has also been applied to social-ecological systems (see especially Gunderson &Holling 2002, *inter alia*) – where it is the cornerstone of the resilience approach – as well as to social and economic systems (Lindgren &Nordahl 1994; Foster and Wild 1999, Pelling &Manuel-Navarette 2011, Simmie&Martin 2009), governance regimes (Scheffer et al. 2002) and even to the evolution of companies (Beinhocker, 2006), with the proviso that its application to the social requires supplementation by approaches more equipped to address specifically social dimensions, such as norms, values, and power relations (Phelan et al. 2013). It is also more difficult to apply this approach in a positivist sense to social-ecological systems, as they can be defined in different

ways according to a vast array of parameters. Nevertheless, as a sensitising heuristic, it is useful, particularly in its emphasis on the different dynamics occurring within the different phases of the evolution of a system, and by extension the different aspects that are important to consider if seeking to enhance the resilience of, or indeed transform a coupled social-ecological-technical system from an unsustainable dynamic, as in a decarbonisation intervention or clean energy transition.

System movement through the four stages of the adaptive cycle is not rigid or predetermined, and systems may find themselves locked into certain dynamics as a result of pathologies during each of these phases. For continuous function over the adaptive cycle, a system needs activation energy or resources to grow, followed by adequate structure and complexity to maintain maturity, and navigate subsequent stages. The process is most elegantly described by Sundstrom and Allen (2019):

> "In the two front loop phases, *r* (exploitation) and *K* (conservation), there is an accumulation of resources and relationships, at first relatively rapidly but slowing as the *K* phase is reached. Systems tend to spend the most time in these phases, and the *K* phase is often understood to be on a stable attractor, or at a quasi-equilibrium in which large-scale system features … are stable over time. As the system moves from the *r* phase of exploitation into the conservation phase, potential and connectedness increase, but resilience shrinks because the high connectedness amongst system elements makes the system vulnerable to cascading disturbances. In the two back loop phases, omega (release) and alpha (reorganisation), dynamics are rapid as the system transitions to a new phase of exploitation. The omega phase is characterised by the rapid release of accumulated resources."

The following presents a more detailed description of these phases, drawn from work examining how to navigate the adaptive cycle (Fath et al. 2015).

**The *r*-stage: growth**

The goal of the r-stage is growth; the trap of this stage is called the "poverty trap".

A system in the *r*-stage has successfully reoriented post-crisis and now seeks the activation energy (resources and information) for rapid growth and development. The system invests those resources during the growth stage to build structure with diverse nodes and flows. This stage is often marked by *abundant resources* and *entrepreneurial leadership*, which exploits niches and opportunities. The system is brimming with untapped and uncommitted potentiality. Once kickstarted along a growth trajectory, many resource flows are available for *experimentation*. In the *r*-stage, *network connections* are established, and *trust and dependencies* are built. Further, in this stage, the dynamics between feedbacks are essential for the system to enter the *K*-stage. Innovation comes from plenty, rather than from constraint, as is the case in the *K*-stage.

The poverty trap occurs when a system cannot access enough activation energy to reach a state where positive feedbacks drive growth internally.

**The *K*-stage: equilibrium/conservation.** The goal of the *K*-stage is controlled development, the trap is the "rigidity trap". Entering the *K*-stage is about making a transition from quantitative increase to qualitative development. Excess resources are unavailable for growth. A mature system in the *K*-stage dynamically performs at a high level of activity while the macro-scale indicators display stable functions. The resource constraints may spur *innovation* through co-creation of networks and information flows that are able to use the input flows more effectively to maintain high levels of structure and organisation (Fath et al. 2004). Disturbances at lower levels can contribute to the resilience of systems by cultivating

a large stock of resources on which they can draw during a crisis. This organisation manifests itself as the internal storage of information and capital (acquired in the growth phase). At this stage, negative feedback cycles dominate over positive, resources become increasingly locked up and the system becomes progressively less flexible and responsive to disturbance.

It is also often desirable to extend the *K*-stage of the adaptive cycle, not in the form of a trap, but rather with continued development in system performance. This may involve the system tending towards a self-organised criticality (or the 'edge of chaos') near the threshold of the present state, where it finds the sweet spot between organisation and disorganisation. This, however, makes them vulnerable to feedbacks that might tip them over into another system state, or processes that reduce the space wherein this criticality is viable. For instance, "a slow changing variable such as climate change likely shrinks the region of criticality, making it easier for disturbances to trigger a system-wide collapse" (Sundstrom &Allen 2019). When positive feedbacks exceed negative feedbacks to the extent of exhausting resources, the system trajectory can overshoot thresholds, sabotaging future system function.

In addition to the possibility of overshoot, the rigidity trap occurs when a system becomes so refined in its processes that there is little room for further innovation.

**The Ω stage: collapse/release.** The goal of the Ω-stage is survival of the system, the trap is the dissolution trap.During the Ω-stage, a disturbance causes a chaotic unravelling and release of resources. The test of a system in the Ω-stage is its capacity to survive in the face of extreme disturbance or disordered collapse. A system must maintain vital functions throughout the crises. In human organisations, it is often up to *leadership*, both assigned and assumed, to identify and prioritise what that means. Crisis coordinators that emerge during this stage are an example of "unpredictable combinations of [de novo entities] with existing components that can suddenly establish new domains of influence, opening an entirely new set of adaptive pathways". Failure to survive this stage results in a complete break of the system cycle. The alternative is the "dissolution trap".

**The α stage: reorganisation/renewal.** The goal of the α-stage is renewal, the trap is the vagabond trap.To reorient after a crisis, systems must reorganise and access capital that has been stored during other stages of the adaptive cycle. During this stage, new actors and new ideas can take hold. Memory in a system is retained if a system has high modularity (Biggs et al. 2012), which helps to prevent failure from penetrating all aspects of system function (May et al. 2008, Levin et al. 2013). The success of navigating through the fast-moving α-stage is largely a function of system development and decisions made in prior stages. It generally leads into another *r*-stage, which may be similar or fundamentally different from the preceding *r*-stage.Being unable to reorient leaves the system in the "vagabond trap".

Although most systems commonly move through this sequence of the phases, there are other possible transitions.

- **Examples/Indicators:**

Although most systems commonly move through this sequence of the phases, there are other possible transitions. There are many pertinent examples of the adaptive cycle applied to systems of relevance to ENTRANCES. For instance, the underlying model of growth economy which informs the JTF decarbonisation interventions (or those of the German *Strukturwandel*), can be taken as an instance of the governance and economic system caught in a rigidity trap, as it is unable to frame these interventions outside of the dominant growth paradigm, and thus the interventions it is seeking to support – which may be part of a renewal/reorganisation stage – may perpetuate the economic growth

pathways that are leading to the ecological overshoot they are supposed to address. This perhaps has more to do with the transformability of the system, but demonstrates the discontinuities between different levels, and that resilience may not be a desirable state of a system that is adversely affecting higher-order (ecological) resilience.

At the level of the energy systems, it is also possible to consider that the energy system in A Coruña has entered a back loop, as the coal-fired energy regime has faced rapid dissolution. Energy systems, such as in Silesia, may be trapped in a rigidity trap, while others may be seeking to make incremental changes to the energy regime without engendering a wholesale collapse of the present system.

- **Type of region:** This framework can be applied to conceptualise change and stability dynamics in all kinds of complex adaptive system, and can therefore be applied in all regions.
- **Regions:** All
- **Gender-sensitive:** No
- **Primary Method:** Desk review /Case specification
- **Method(s):** N/A
- **Internal relations (explained):** This relates to the SES patterns (outlined below), in that they refer to this model of system dynamics, and different interventions may be appropriate at different stages of the adaptive cycle. It also bears resemblance by analogy to the multilevel perspective (MLP) and its related “stages of transition”.
- **Possible overlap:**
- **Sources:**

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- **Other comments:** This framework may be useful for identifying the transition phase of a regional system, thus orienting our selection of transformative capacity factors, but is to be thought of as a sensitising heuristic, not itself a topic for detailed research in the frames of this project.

### *2.3.2. The Multilevel Perspective (MLP) on socio-technical transitions*

- **Code:** C5-D02
- **Type:** Dynamic
- **Factor Description:**

The multi-level perspective (MLP) conceptualises socio-technical transitions, defined as large scale and long-term shifts in socio-technical systems through which societal functions are fulfilled. It combines ideas from evolutionary economics, sociology of technology, and institutional theory to present a quasi-evolutionary theory of change dynamics in specific kinds of complex adaptive system, with the causal mechanisms stemming from the interplay of multiple developments at three analytical levels: niches (the locus of radical innovations), socio-technical regimes (the locus of established practices and associated rules), and an exogenous socio-technical landscape.

It has been applied to a range of sociotechnical systems to analyse such things as the shift from sail to steam-powered shipping and from horse-drawn carriages to automobiles (Geels, 2005b). Yet it has seen particular application in the study of sustainability transitions, for which studies of transitions in national energy systems, are often taken as the model, especially in the transition from fossil fuel-based energy systems to renewables (e.g., Verbong and Geels 2007, Geels 2018, Göpel 2019). As with SES approaches, application of the MLP relies on a definition of the system in question, which can, for an energy system, be at the level of a primary fuel (e.g., coal) or at the level of an entire system for the production, distribution, and consumption of electricity, or in other ways (the regional economic development apparatus), depending on the research interest.

The following relies on Geels's own explanation of the MLP, as well as that of Schot and Kanger. I cover the basic dynamic of the MLP, as well as the phases of transition that can be identified, and which find their parallel in the stages of the adaptive cycle discussed above.

***Regimes:*** Regimes can be defined as shared semi-coherent (i.e. relatively stable and aligned) sets of rules or routines directing the behaviour of actors on how to produce, regulate and use technologies part of a specific socio-technical system. These rules are embedded in the various elements of the system – for example, in the case of land-based transportation this includes industry structure, vehicle design, fuel infrastructure, maintenance and distribution network, road and traffic infrastructure, regulations and policies, markets and user practices, culture and symbolic meanings – and they shape innovative activities towards a specific trajectory of incremental innovation (e.g. engineering efforts aimed at increased fuel efficiency, marketing efforts focused on differentiating stable user preferences regarding the features of new automobiles, scientific research for traffic optimisation, etc.). The MLP's focus is thus on the increasing alignment of sets of rules over time, i.e., the formation of socio-technical regimes that manifest themselves as socio-technical systems.

***Niches:*** Technological niches form the micro-level where radical novelties emerge. These novelties are initially unstable sociotechnical configurations with low performance. Hence, niches act as 'incubation rooms' shielding emerging new and unstable technologies from direct market pressure. Niche-innovations are carried and developed by small networks of dedicated actors, often outsiders or fringe actors. Compared to dominant regimes, the actors in niches are few, their interrelations sparse, the focal technology immature and the guiding rules in constant flux. Although they may have potential, their performance remains too weak to compete with incumbent technologies. For this reason, niches often need to be protected from pressures exerted by the incumbent socio-technical regimes until they have become mature enough to enter the market.

***Landscape:*** The sociotechnical landscape forms an exogenous environment beyond the direct influence of niche and regime actors. This includes macro-economics, deep cultural patterns, and macro-political developments, long-term trends such as globalisation, urbanisation and climate change, but also events such as wars, natural disasters, and economic crises. These heterogeneous factors can be combined in a single 'landscape' category because they form an external context that niche and regime actors cannot influence in the short run.

The multi-level perspective argues that transitions come about through interactions between processes at these three levels: (a) niche-innovations build up internal momentum, through learning processes, price/performance improvements, and support from powerful groups, (b) changes at the landscape level create pressure on the regime and (c) destabilisation of the regime creates windows of opportunity for niche-innovations. The alignment of these processes enables the breakthrough of novelties in mainstream markets where they compete with the existing regime.

The process of transition is far from a moderate and rational consensus-oriented debate about best solutions to clearly defined problems: instead, it is rife with struggles between regime-actors and niche-actors with conflicting interests, differing time-scales, problem definitions and perceived best courses of action. This is not well reflected, however, in many applications of the MLP, in which these conflicts may be flattened out by its wide-angle systemic perspective.

**Phases of Transition**

Given the above model for socio-technical transition, certain phases of transition can be extrapolated: pre-development, take-off, acceleration, stabilisation (Rotmans 2001). This is analogous to the stages of the adaptive cycle, outlined above (C5-D01).

***Pre-development/Emergence:*** the system is in a dynamic state of equilibrium and changes slowly but unobtrusively. "In the first phase of transitions, radical innovations emerge in niches, often outset or on the fringe of the existing regime. The social network of niche innovators is unstable and fragile with lots of entry and exit. There are no stable rules in this early phase. Various design options co-exist, linked to different social networks with diverging views and visions. There is much uncertainty about technological characteristics, user preferences, policy, infrastructure requirements, and cultural meaning. The phases is therefore characterised by experimentation and trial-and-error learning … niche innovations do not yet form a threat to the existing regime, which is entrenched in many ways (institutionally, organisationally, economically, culturally). Incremental changes in regime technologies, policy, markets, and cultural meanings continue along relatively predictable trajectories."

***Take-Off/Formative phase:*** more coordinated niche activity and regime reactions gain momentum. These may lead to the tipping points. "In the second phases of transitions, innovations break out of protected technological niches and establish a foothold in one or more market niches. This provides a more reliable flow of resources, which stabilises the innovation, making it more attractive for new entrants. Learning processes gradually stabilise into a dominant design, which becomes institutionalised in design guidelines, product specifications and best-practice formulations carried by a dedicated community of firms, engineers, policymakers, and users. The innovation thus develops a trajectory of its own because of the stabilisation of rules and social networks. Learning processes tend to focus on functionality and performance rather than cost … Innovations may remain stuck in market niches for a long time, especially when they face a mismatch with the existing regime. As long as the regime remains stable, niche innovations often have little chance to diffuse more widely. Niche innovations and actors can seek to fit-and-conform by competing with the present regime on its terms, or seek to stretch-and-

transform the regime structures to make them more amenable to the innovations (although this may face resistance from incumbents)."

***Acceleration/Wide diffusion and breakthrough:*** structural changes become possible and visible but hard to control. "The innovation diffuses into mainstream markets where it competes head on with the existing technology and wider socio-technical regime. Diffusion depends internally on improvements within the niche (price/performance improvements, economies of scale, development of complementary technologies, support from powerful actors) and also on external landscape developments that put pressure on the regime, leading to a window of opportunity. Such pressures could be performance problems that cannot be met with existing technology, changes in markets and user preferences, changing discourses that delegitimise existing technologies, changes in policy leading to stricter regulations. This can involve conflict through market competition, responses by incumbent firms (buying up niche companies, improving their own technology, reorienting themselves), political struggles, including over subsidies, taxation and regulation, and cultural/discursive struggles in the public sphere over the framing of problems and solutions"

***Stabilisation/Institutionalisation:*** **"**a new dynamic system setting emerges. This can be a transformed system in which the overall development trajectory is different, because it is informed by many niche elements and ideas. However, this can also be an adapted version of the old dynamic in which most of the challenges have been absorbed or subjugated by the old regime structures, so that some aspects are amended but the general development trajectory stays the same. In a third alternative, the system can collapse when it falls out of the order imposed by the former dynamic, should restabilising feedbacks and activities be insufficient (Grin et al. 2010: 3–7)."

It is important to note that there is nothing necessarily transformative about the evolution of socio-technical systems. Although new technologies may emerge, and radically alter both landscapes and regimes, change can also be path-dependent and continue along the same paradigm. Indeed, all studies of historical and present-day socio-technical transitions effectively model path-dependent change, because they depend on market selection within a profit-seeking growth model as the primary selection mechanism. To effect path-deviant change requires intervention into these processes to break this deep structuration, an approach that is explored by Schot and Kanger (2018) under the rubric of *Deep Transitions*. this seeks to conceptualise a complete paradigm change entailing interactions between multiple regimes and systems of an order similar to Polanyi's *Great Transformation*, which led to the advent of modern-day capitalism.

- **Examples/Indicators:** German *Energiewende*
- **Type of region:** All
- **Regions:** All
- **Gender-sensitive:** Yes, both in terms of the system properties and the tools (methodological approaches) used to understand them.
- **Primary Method: n/a**
- **Method(s): n/a**
- **Internal relations (explained):** This relates by analogy to the Adaptive Cycle discussed above. The phases of transition relates also by analogy to the Transformation pattern discussed below.
- **Possible overlap:**
- **Sources:**
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- **Other comments:**

## 2.4. Patterns

The broad dynamics outlined in the previous section can result in different outcomes depending on the internal relations and interactions between different elements of systems, as well as exogenous pressures acting on them. Although, strictly speaking, everything is dynamic in complex adaptive systems, these outcomes may be thought of as patterns. In SES, these relate either to the system remaining within a stability domain (or regime), or falling out of it and transforming into another system. These are alternatively conceptualised as **Resilience (P01)** and **Transformation (P02)**. The resilience and the transformation of systems may be desirable or undesirable, intended or unintended, purposive or emergent, and this is addressed within each pattern as "perverse resilience" (or "lock-in") and "emergent transformation" or "change by disaster" as opposed to "change by design", or "purposive transformation").

In STS, partly because of differences in focus – between frameworks which place more emphasis on agency/governance in transitions and those which adopt a broader evolutionary approach – there is some controversy over what factors interact to produce which kinds of pattern. Adopting the former standpoint, Smith et al. (2005) identify a different 'transition pathways' dependent on (i) *whether change is envisaged and actively coordinated* and (ii) *the degree to which responses to selection pressures are based on resources available within the regime*. This results in a typology of four different transition pathways: endogenous renewal, reorientation of trajectories, purposive transition, and emergent transformation. Geels and Schot (2007) reject this typology, preferring instead to identify the *timing* and *nature* of niche-regime interactions as crucial. This leads to a typology consisting of substitution, transformation, reconfiguration, and de-alignment and re-alignment. De Haan and Rotmans (2011) attempt a synthetic approach, which considers whether the impetus for change is *top-down*, *bottom-up*, *squeezed between these pressures*, or *internally induced*, and the*influence the incumbent regime has* on the unfolding transition (i.e., if it is able to incorporate or if it is replaced). This leads to a typology of 11 patterns, which incorporates many of the dimensions discussed in the previous articles. These are addressed under the rubric **Transition Pathways (P03)**.

As with SES, the null hypothesis is also possible, that the system simply reproduces itself without significant modification, and this can also be conceived of as lock-in (see, e.g., Klitkou et al. 2015; or Dornelles et al. 2020, for an interdisciplinary conceptualisation). Alternatively, a system can simply collapse.

***Note:*** There is an important difference in terminology between SES and STS. In SES transformation is used to denote path-deviant change, whereas in STS transformation indicates "the processes through which the regime changes through continued adaptation" (de Haan &Rotmans 2011: 93). There is no way to resolve these contradictory definitions, and we instead adopt the view that transformation implies fundamental change in system identity, structure and function, comparable to the STS notion of transition.

### *2.4.1. Resilience(and Perverse Resilience)*

- **Code:** C5-D01
- **Type:** Dynamic
- **Factor Description:**

In addition to the adaptive cycle, where a system is understood to change in the form of a loop, moving from exploitation (*r*) to conservation (*K*), in the growth phase, to release (Ω) and reorganisation (α) in the back loop, another key way of understanding socio-ecological systems is in terms of their likelihood of crossing a threshold and moving into a different regime. For this the idea of basins of attraction (also known as stability landscapes or regimes) is pertinent.

This model is usefully described with the metaphor of a ball in a basin. The important variables used to describe a system are known as the system's "state" variables. If the system consists of the number of fish and the number of fishers, it is a two-dimensional system. If it consists of the amount of grass, trees, livestock, and people employed in ranching, it is four dimensional. The collection of variables in the system will all act in relation to each other to maintain it within a particular basin of attraction. This is not an equilibrium state, all the parts are constantly moving and adjusting to each other. But a change to these variables can either push the system out of the domain of attraction, shift the domain of attraction itself, or lower the threshold between two different domains of attraction, making it easier for the system to slip out and enter into a new regime.

Systems exist within basins of attraction. They can vary quite strongly within these basins – fish populations can wax and wane, insect populations can vary even more so – but the combination of feedbacks tends to maintain them within a stable domain. The propensity to remain within the stability landscape or to exceed it and tip into a new system state can be conceptualised in terms of the patterns resulting from these system dynamics, the endogenous processes and exogenous drivers acting upon it. These patterns may be either desired or undesired, purposive or emergent, thus permitting one to conceptualise desirable resilience and perverse resilience (lock-in) on the one hand, in which the system remains in the same stability regime, or transformation (purposive or emergent), in which the system enters into a different stability landscape.

It is often desirable to retain a social-ecological system within a certain stability landscape. This can be on a small scale, such as retaining a clear water regime in a lake, as opposed to a turbid (murky) water regime. Or it can be at the scale of a regional social-ecological system (a farming system or wetland), or even the planetary climate system: the risk of global heating is that we tip from the Holocene (the stability landscape within which human civilisation has developed and thrived) into a new "hot-house earth" state, which because the change is nonlinear and characterised by tipping points, makes it difficult or even impossible to reverse. These dynamics can also apply to human-dominated social-ecological systems (including socio-technical systems embedded within social-ecological systems) and other forms of complex adaptive system.

The capacity of a system to absorb disturbance and reorganise while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks (i.e., not tip into a different system state or basin of attraction) is defined as resilience. Some loss of resilience, at some scales, is an inevitable feature of the cross-scale dynamics in complex adaptive systems. Generally, however, a system that loses resilience at small, and more societally manageable scales of organisation will be more resilient than one where losses occur at larger scales (Walker et al. 2004). On the other hand, resilience is not always a good thing. Sometimes change is desirable, generally at larger scales, and then effective management requires overcoming the resilience in the system to precipitate changes at these scales. As consideration of the Holocene example, above, implies, the functioning of many social

systems, which display great resilience, contributes enormously to the loss of Earth System resilience, and therefore social change (transformation) must be an essential component of SES resilience. Here we shall consider resilience in terms of adaptive maintenance of the system in its present regime.

Another crucial question when considering resilience, is "resilience of what to what" (Carpenter et al. 2001). For instance, if actors in a farming system conceive of the resilience challenge as responding to shocks in the form of periodic drought, they may seek drought-resistant crops, if they see the challenge in terms of stresses, i.e., increasing and long-term water shortage, they may reorient the farming system altogether to other kinds of crop or systems of production.

According to Walker et al. (2004), there are four crucial aspects of resilience, which can apply to systems at different nested scales:

1. Latitude: the maximum amount a system can be changed before losing its ability to recover (before crossing a threshold which, if breached, makes recovery difficult or impossible).
2. Resistance: the ease or difficulty of changing the system; how "resistant" it is to being changed.
3. Precariousness: how close the current state of the system is to a limit or "threshold."
4. Panarchy: because of cross-scale interactions, the resilience of a system at a particular focal scale will depend on the influences from states and dynamics at scales above and below. For example, external oppressive politics, invasions, market shifts, or global climate change can trigger local surprises and regime shifts.

"The collective capacity of actors in a system intentionally to manage resilience determines whether they can successfully avoid crossing into an undesirable system regime, or succeed in crossing back into a desirable one. There are four ways to do this, corresponding to the four aspects of resilience. Actors can move thresholds away from or closer to the current state of the system (by altering (1) above), move the current state of the system away from or closer to the threshold (altering 3), or make the threshold more difficult or easier to reach (altering 2). In addition, actors can manage cross-scale interactions to avoid or generate loss of resilience at the largest and most socially catastrophic scales (altering 4)" (ibid.)

The capacities for managing social-ecological systems for resilience relate to the ability adaptively to maintain the identity, feedbacks, structures and functions of a system. There are many frameworks for considering adaptive capacity, and certain capacities may vary according to the system's location in the adaptive cycle (Fath et al. 2015). Marshall et al. (2012), for instance, identify the following characteristics as important: possessing creativity and innovation (for identifying solutions or adaptation options), testing and experimenting with options, recognising and responding to effective feedback mechanisms, employing adaptive management approaches, possessing flexibility, being able to reorganise given novel information, managing risk, and, having necessary resources at hand.

Importantly, it has been observed that the features necessary for adaptive capacity, may be different from those of transformative capacity (Marshall et al. 2012; Wilson et al. 2013; Brown et al. 2011).

- **Examples/Indicators:**
- **Type of region:** This framework can be applied to conceptualise transformative interventions in all systems, and can therefore be applied in all regions.
- **Regions:** All
- **Gender-sensitive:** No
- **Primary Method:** Case specification
- **Method(s):** n/a
- **Internal relations (explained):**
- **Possible overlap:**

- **Sources:**
- **Other comments:**

### *2.4.2. Transformation*

- **Code:** C5-P02
- **Type:** Factor/Dynamic/Pattern
- **Factor Description:**

As discussed in relation to resilience, it is sometimes necessary to seek to transform systems. Transformation is “the creation of a fundamentally new system when ecological, economic, or social (including political) conditions make the existing system untenable” (Walker et al. 2004). It implies a fundamental rewiring of the SES, its structure, functions, feedbacks, and properties, including in the way that power, authority and resources are structured and flow through systems; the norms, values, and beliefs that underpin those structures and processes, and the rules and practices (laws, procedures, customs) through which they are embodied; the functions and dynamics of ecosystems; and the ways that all of these are connected to one another across multiple scales. Actors do not control the course of a transformation; rather, they can only steer it somewhat toward their goals and influence the trajectory of the transformation process (Westley et al. 2013). It is posited that change in certain core components has the potential to change the dominant feedbacks existing in an SES, consequently allowing a transformation to occur, and certain types of change have more leverage than others (Meadows 1999). This forms the basis of Göpel’s(2019) Great Mindshift framework, which identifies a paradigmatic transformation in society’s thinking about the world as a necessary part of a transformation towards sustainability.

Change in system dynamics is achieved not only by creating radically different paths for development, but also by breaking down the resilience of features of the current systems that constrain transformation, and creating space for exnovations and unmaking of problematic dynamics (Feola 2019, 2020). “The notion of breaking down the resilience of one development pathway while building an alternative distinguishes transformation from adaptation; the latter generally involves building resilience for some people or some subsystem of the existing pathway” (Reyers et al. 2018).

It is worth noting the obvious parallels in literature on SES transformation and the STS literature discussed in relation to the MLP.Transformation of an SES is beset with difficulties because incumbent structures are typically mutually reinforcing and small perturbations can be accommodated through adaptation (Park et al. 2012). Powerful actors may also resisttransformation pressures and work to keep the dominant system in place.As in the MLP, transformationsare thus considered to occur as the result of a confluence of transformational pressures at different scales (Smith et al. 2005).

An important trigger for transformation efforts can be ecosystems reaching a tipping point and moving toward a new regime that is entirely undesirable to anyone within the social system (Scheffer et al. 2001, Biggs et al. 2009), but by this time it may be too late and the transformation may be forced (change by disaster). The more hopeful scenario, and the one that we address here, is one of deliberate transformation, in which actors intentionally seek to disrupt a dominant state that has become rigid but which locks the system into an unsustainable trajectory.

**Transformation Phases**

Transformations focus on social-ecological relations and feedbacks, as well as the nonlinear nature of these reconfigurations. In this sense, transformations can be seen as a type of systemic change or regime shift. This implies that instead of a smooth transition, there are thresholds of change, where

progress can involve different activities at different times. Moore et al. (building on Olsson et al. 2004, 2006, 2008) describe transformation as a process with distinct phases, and different kinds of activity most appropriate to each phase. The phases are identified as follows: (1) triggers or pre-transformation, (2) preparing for change, (3) navigating the transition, and (4) institutionalising the new trajectory. This parallels the phases of transition model in STS.

**1. Triggers or pre-transformation.** Characterised by major social or ecological disruptions, which in turn, create windows of opportunity. Opportunity contexts change throughout the process of transformation but typically become transparent enough at certain points for agents to navigate to another phase.

**2. Preparing for change.** This involves (a) sensemaking (analysing the structures that are most problematic for current trajectory), (b) envisioning (generating new innovations and visions for the future), (c) gathering momentum (self-organization around new ideas, creating and mobilising support networks, and experimenting in protected "niches").

**3. Navigating the transition.** This entails (a) selecting (choosing which innovation or change process in which to invest social, intellectual, and financial capital), (b) learning (evaluating the results of earlier experiments and developing shared understandings or new forms of knowledge), and adoption (widespread uptake or replication of innovative change that was successful in experimental stage), hopefully leading to a tipping point in which the system changes fundamentally.

**4. Institutionalising the new trajectory.** This involves processes of (a) routinisation (managing dynamic stability to embed new trajectory and establish or strengthen new feedbacks), (b) strengthening cross-scale relationships (scaling up the change, which often involves a different type of innovation than was created originally in niche), and (c) stabilization: the transformed system may reach a new "attractor" but still face active resistance from powerful actors at different scales, and actors need, in any case, to deal with next, unanticipated perturbations.

For Göpel, "only if the stabilization phase is oriented around a shifted paradigm will the new development dynamic of the system be radically different—or transformed. Put differently: transformation means changing the default. Ideas and solutions that have to justify their appropriateness and argue their legitimacy today will become the new normal" (Göpel 2019)

- **Examples/Indicators:**
- **Type of region:** This framework can be applied to conceptualise transformative interventions in all systems, and can therefore be applied in all regions. It is, however, highly unlikely that transformation will be identified in any regions, as they are all in the early stages of a decarbonisation transition.
- **Regions:** All
- **Gender-sensitive:** No
- **Primary Method:** n/a
- **Method(s):** n/a
- **Internal relations (explained):**
- **Possible overlap:**
- **Sources:**
- **Other comments:**

### *2.4.3. Transitions Pathways in STS*

- **Code:** C5-P03
- **Type:** Pattern
- **Factor Description:**

Partly as a result of different emphases in theorising – some frameworks place more emphasis on agency/governance in transitions, others adopt a broader structural approach, and still others seek to understand them yet more heuristically – there is some controversy over which factors might interact to produce which kinds of pattern, and therefore which kinds of transitions pathways might exist.

Adopting a focus apt to understand purposive transitions, Smith et al. (2005) identify different transition pathways dependent on (i) *whether change is envisaged and actively coordinated* and (ii) *the degree to which responses to selection pressures are based on resources available within the regime*. This results in a typology of four different transition pathways: endogenous renewal, reorientation of trajectories, purposive transition, and emergent transformation. From a more structuralist standpoint (by virtue simply of their attempt to capture the process at a macroscopic scale) Geels and Schot (2007) reject this typology, and prefer instead to identify the *timing* and *nature* of niche-regime interactions as crucial. This leads to a typology consisting of substitution, transformation, reconfiguration, and de-alignment and re-alignment. De Haan and Rotmans (2011), on the other hand, attempt a synthetic approach, which considers whether the impetus for change is *top-down*, *bottom-up*, *squeezed between these pressures*, or *internally induced*, and the *influence the incumbent regime has* on the unfolding transition (i.e., if it is able to incorporate or if it is replaced). This leads to a typology of 11 patterns, which incorporates many of the dimensions discussed by the other authors. As with SES, the null hypothesis is also possible, that the system simply reproduces itself without significant modification, and this can be conceived of as lock-in (see, e.g., Klitkou et al. 2015) or failed transition. Alternatively, a system can simply collapse.

The patterns are as follows (drawn from de Haan and Rotmans 2011):

**Top-down transition paths – *Reconstellation dominated***

**Radical reform (with regime adaptation).**

The regime is reformed according to the cultures and structures of some outside constellation, for instance, EU framework directives forcing local governments to reform their institutional structures. Many institutional transitions and public reformsare of this type.

**Revolution (without regime adaptation)**

A constellation outside the regime invades the societal system and replaces the incumbent regime. Political and socio-economic revolutions can be considered of this type. Also governments providing new structures in sectors that were formerly self-regulating or locally arranged have characteristics of this type, centralising healthcare financing for example.

**Collapse (failed transition)**

A reconstellation dominated path does not necessarily lead to a new stable societal system. Similarly, radical reform transitions like privatisations of entire sectors can lead to deterioration of the societal functioning of such a sector, like the privatisation of the railways in the UK. Similarly large scale collectivisations have been known to lead to badly functioning systems, like the collectivisation of Cuban agriculture.

**Bottom-up paths – *Empowerment dominated***

**Reconfiguration (with regime adaptation)**

One or several niches are empowered and become a niche-regime which in turn takes on the role of the dominant constellation thus becoming the new societal regime. This is similar to Geels and Schot's socio-technical reconfiguration path, although their re-alignment/de-alignment pathway can also easily be classified as this type since in essence it is about niches scaling up and becoming empowered by the regime and not in spite of it like in the following substitution path.

**Substitution (without regime adaptation)**

Like reconfiguration with the difference that the regime is not involved in the empowerment process. The niche or niches scale-up on their own force or merits and the subsequently emerging niche-regime successfully competes with the regime and takes it place. Technological substitutions are of this type, but one can also thinkof new popular political parties invading the political landscape.

**Backlash (failed transition)**

Niches initially gain in power or popularity, while their novel way to meet societal needs still fails to become the new mainstream. This can happen if the demand for certain functioning grows too rapidly and the niche is unable to consolidate this and consequently cannot cope with for instance swings in demand. Another possible path to a backlash can be that some novel functioning is initially adopted by many until some unforeseen risk or problem becomes apparent and the niche is abandoned.

**Squeezed paths – reconstellation and empowerment of similar influence**

**Teleological (with regime adaptation)**

A regime adapts to changed circumstances not by reforming itself but by allowing outside influences to reconstellate structures and cultures and simultaneously incorporating novel functioning in these processes. If the regime is actively adapting and steering in transition processes, connecting niches with landscape developments one can almost speak of a managed transition. This led to an idea of "transition management", a governance framework to propagate this type of transition.This corresponds to Smith et al.'s "purposive transition" characterised by high co-ordination and much influence from outside the regime.

**Emergent (without regime adaptation)**

Niche functioning and influences from outside the societal system somehow team up to a transition without active influence of the incumbent regime. For instance, in the communication revolution of the past decades, niche functioning like mobile telephony and internet use, empowered by technological developments and reconstellated through liberalisation of communication markets, led to a transition from the then reigning communication regime, roughly speaking characterised by phone, fax and postal services.This transition path would correspond Smith et al.'s "emergent transformations, where low co-ordination is combined with influences and novelty from outside the regime".

**Lock-in (failed transition)**

This can be the case if, stimulated by government schemes or international pressure, the regime incorporates and stimulates a different way to fulfil a societal need, say a new energy production technology or liberalisation of internal markets and this novel way is not sufficiently developed or too incompatible with current structures or demands. This would then lead to the situation of an alternative functioning in the margin of the mainstream or in a troublesome manner.

**Transformation paths –*Adaptation dominated***

**Transformation**

The regime essentially transforms on its own, successfully adapting to the point that societal needs

are again met adequately and no tensions or stress plague it. Adaptation can have taken the form of absorbing niche functioning or co-evolution with it.This transformation path is similar to the socio-technical one of Geels and Schot. If interpreted as possible unfoldings of transitions the transition contexts “reorientation of trajectories” and “endogenous renewal” of Smith et al. are of this type as well, because of their focus on the “internal adaptation” of the regime.

**System breakdown (failed transition)**

Attempts of the regime to adapt do not lead to a new societal equilibrium and the regime cannot meet the societal needs adequately any more. Various forms of societal collapse can be classified under this type.

# 3. Literature overview

## 3.1. Overview

Research for this scoping review sought initially to identify the various strands of thinking in SES and STS. There are several frameworks in SES, ranging from Ostrom's general framework to more resilience based approaches. Ostrom's "institutional analysis and development" framework to investigate how the resource system, resource units, actors and governance system interact, was deemed unsuitable for this research project because it focuses on the management of (renewable) resources, whereas this research focuses on the possibility of effecting systemic transformation. Approaches that emphasise and theorise transformation as a component of resilience were therefore deemed more appropriate.

Regarding STS, the focus was initially on identifying the different approaches to socio-technical systems. A number of analytical frameworks exist that act as heuristics to represent the complexity and multi-dimensionality of sustainability transitions and shifts in socio-technical systems (Köhler et al., 2019). The main frameworks reported in detail by Köhler et al. (2019: 4) include the Multi-Level Perspective (MLP) (e.g. Geels, 2002; Rip and Kemp, 1998), the Technological Innovation System approach (TIS) (e.g. Bergek et al., 2008; Markard et al., 2015), Strategic Niche Management (SNM) (e.g. Rip and Kemp, 1998; Schot and Geels, 2008), and Transition Management (TM) (e.g. Loorbach, 2010; Rotmans et al., 2001). These analytical frameworks frame sustainability transitions as the evolution of socio-technical processes, provide big-picture insights for long-term energy and low-carbon transitions, and cover the role of actors and their interactions, cultures, practices, innovation development and implementation, governance arrangements and so on (Geels, 2012, 2002; Rip and Kemp, 1998; Sovacool and Hess, 2017). Additionally, certain strands of this literature introduce a critical dimension, interrogating the implications of politics and power on sustainability transitions.

Useful overviews can be found here:

European Environment Agency. 2017. Perspectives on transitions to sustainability. EEA Report No. 25/2017

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ENergy TRANsitions from Coal and carbon: Effects on Societies

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K&I Knowledge and Innovation

IWH Halle Institute for Economic Research
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Leibniz Institute of Ecological Urban and Regional Development

ZSI

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